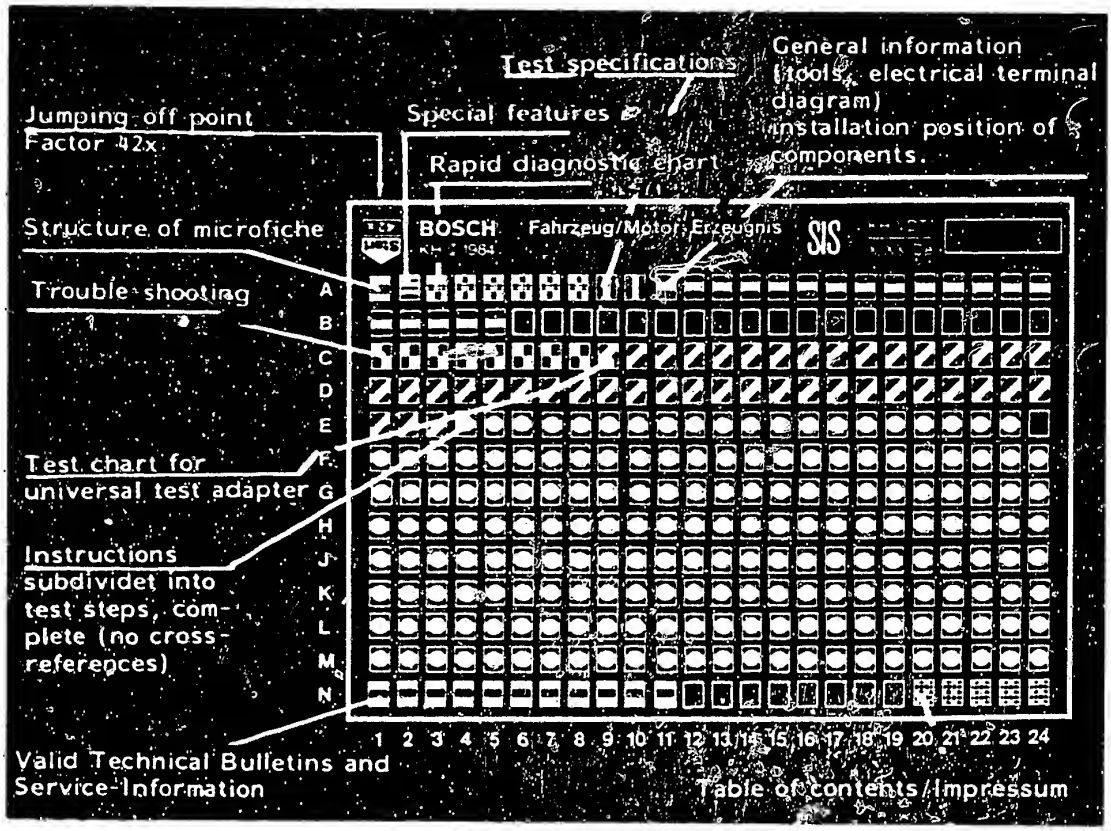
Structure of microfiche



1. Read from left to right

2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section

Beginning	Mid-section	End	One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

C6

Special features

- Digital L2 control unit
- Air-flow sensor with logarithmic characteristic, i.e. the vehicle-specific adaptation is made in the L2 control unit.
- Main relay and pump relay
- Cold-start control
- Overrun cutoff effective only as of engine temperature +60°C
- Idle and full-load microswitches

EU version:

- Idle-speed control (non-Bosch product)
- TD triggering

EU version as of 7.84 additionally with:

- Digital idle stabilization (DIS) (non-Bosch product) Ignition distributor with double vacuum unit instead of previously single unit.

US version:

- Digital idle stabilization (DIS) (non-Bosch product)
- Lambda closed-loop control 3-way catalytic converter
- Auxiliary-air device

Only the peripherals are checked when testing with the universal test adapter and the L2 adapter lead.
EU version has control unit 0 280 000 508/509
US version has control unit 0 280 000 501/502

Rapid diagnosis chart for universal test adapter

The following rapid diagnosis chart makes it possible for the experienced L-Jetronic expert to quickly check the electrical part of the system using the universal test adapter.

The rapid diagnosis chart contains the following information:

- Switch settings on the universal test adapter
- Sequence of test steps
- Notes on how to operate the universal test adapter or other components
- Readings on the multimeter
- References to coordinates of the respective, detailed testing and trouble-shooting program

If detailed information and instructions are required, always proceed according to the trouble-shooting program starting on Coordinate C1/C2.

Test step	Switch setting		Measurement	Remarks	Test specifications (reading)	for trouble-shooting see Coordinates
	V	Ω				
1	4	-	Voltage from starting motor term. 50 On control-unit plug between term. 7 and term. 21	Shift gear to neutral, start	8 ... 15 V	C 12
2	5	-	Signal from term. TD. On control-unit plug between term. 1 and term. 7	Shift gear to neutral, start	2 ... 8 V	C 16
3	6	-	Voltage at main relay term. 87. On control-unit plug between term. 7 and term. 13	Shift gear to neutral, start	8 ... 15 V	C 20
4	7	-	Ground signal at pump relay term. 86. On control-unit plug between term. 7 and term. 20	Shift gear to neutral, start	8 ... 15 V	D 1

Rapid diagnosis chart for universal test adapter

Test step	Switch setting V	Switch setting Ω	Measurement	Remarks	Test specifications (reading)	for trouble-shooting see Coordinates
5	↓	5	Resistance of temperature sensor II (engine temperature) On control-unit plug between term. 2 and term. 7		(+15°C...+30°C): 1.45 ... 3.3 kΩ (+80°C): 280 ... 360 Ω	D 5
6	↓	6	Resistance of temperature sensor I (intake-air temperature) in air-flow sensor. On control-unit plug between term. 14 and term. 7		(+15°C...+30°C): 1.45 ... 3.3 kΩ (+80°C): 280 ... 360 Ω	D 7
7	↓	7	Resistance of potentiometer in air-flow sensor. On control-unit plug between term. 15 and term. 7	Deflect air-flow sensor flap as far as it will go	8 ... 1000 Ω	D 9
8	↓	8	Resistance in air-flow sensor. On control-unit plug between term. 19 and term. 7		500 ... 800 Ω	D 11
9	↓	9	Resistance of idle and full-load contacts. On control-unit plug between term. 4 and term. 7	1. Throttle valve closed 2. Throttle valve fully open	1. 0 ... 10 Ω 2. 0 ... 10 Ω	D 13
10	↓	11	Resistance of output stage ground On control-unit plug between term. 25 and term. 7		0 ... 10 Ω	D 17

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch setting V	Switch setting Ω	Measurement	Remarks	Test specifications (reading)	for trouble-shooting see Coordinates
11	↓	12	Resistance of solenoid-operated injection valve 1 and electric fuel pump. On control-unit plug between term. 12 and term. 7		Ambient temperature (+15°C...+30°C): 14 ... 24 Ω engine at normal op.temp. (+80°C): 16 ... 26.5 Ω	D 19
12	↓	13	Resistance of solenoid-operated injection valve 2 and electric fuel pump. On control-unit plug between term. 11 and term. 7			D 21
13	↓	14	Resistance of solenoid-operated injection valve 3 and electric fuel pump. On control-unit plug between term. 24 and term. 7			D 23
14	↓	15	Resistance of solenoid-operated injection valve 4 and electric fuel pump. On control-unit plug between term. 23 and term. 7			E 1

C5

Pressure regulator

- Fuel pressure 2.3...2.7 bar

C5

Electric fuel pump

- Fuel delivery (measured in return) min. 550 cm³/30s
- Terminal voltage (under load): min. 12 V

C5

Temperature sensor II (engine) Color of plug blue and temperature sensor I (intake air) in air-flow sensor between (term. 1 and 4)

- electrical internal resistance at:
  ambient temp. (+15°...+30°C): 1.45...3.3 kΩ
  engine at op.temp. (approx.+80°C): 280...360 Ω

C5

Solenoid-operated injection valve

- electrical internal resistance at (+15°...+30°C) 15...17.5 Ω

C5

Air-flow sensor

- electrical internal resistance
  between term. 2 and term. 3
  (sensor flap fully deflected): 8 ...1000 Ω
  between term. 3 and term. 4 500...800 Ω

C5

Auxiliary-air device (US version only)

- electrical internal resistance 20 ... 55 Ω

Idle adjustment

C7

- Europe version

  Ensure the following before testing:
  1. Engine at normal operating temperature approx. +80°C
  2. Disconnect hose for crankcase ventilation from oil breather and plug tight.
  applies only as of 7.84
- Disconnect vacuum hose from retard unit of ignition distributor and seal off.
- Disconnect plugs from DIS control unit and plug together.

  all EU versions

  3. Disconnect plug-in connection from term. 1 of ignition coil to control unit for idle-speed control:
  830...930 min^{-1}
- US version (1. and 2. above apply)

Digital idle stabilization connected: 850...950 min^{-1}
Digital idle stabilization not connected: 800...900 min^{-1}

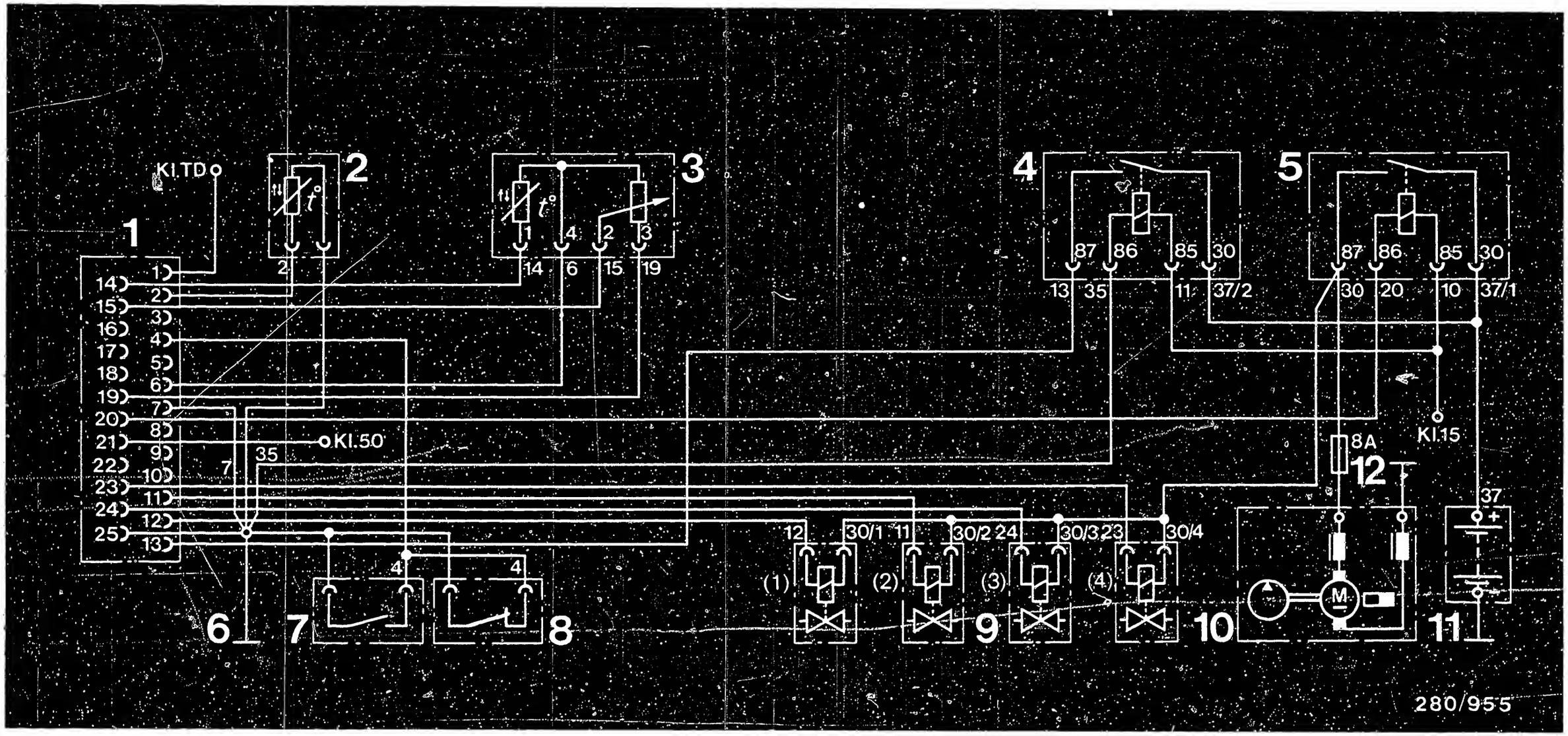
CO adjustment

C7

with idle speed correctly adjusted

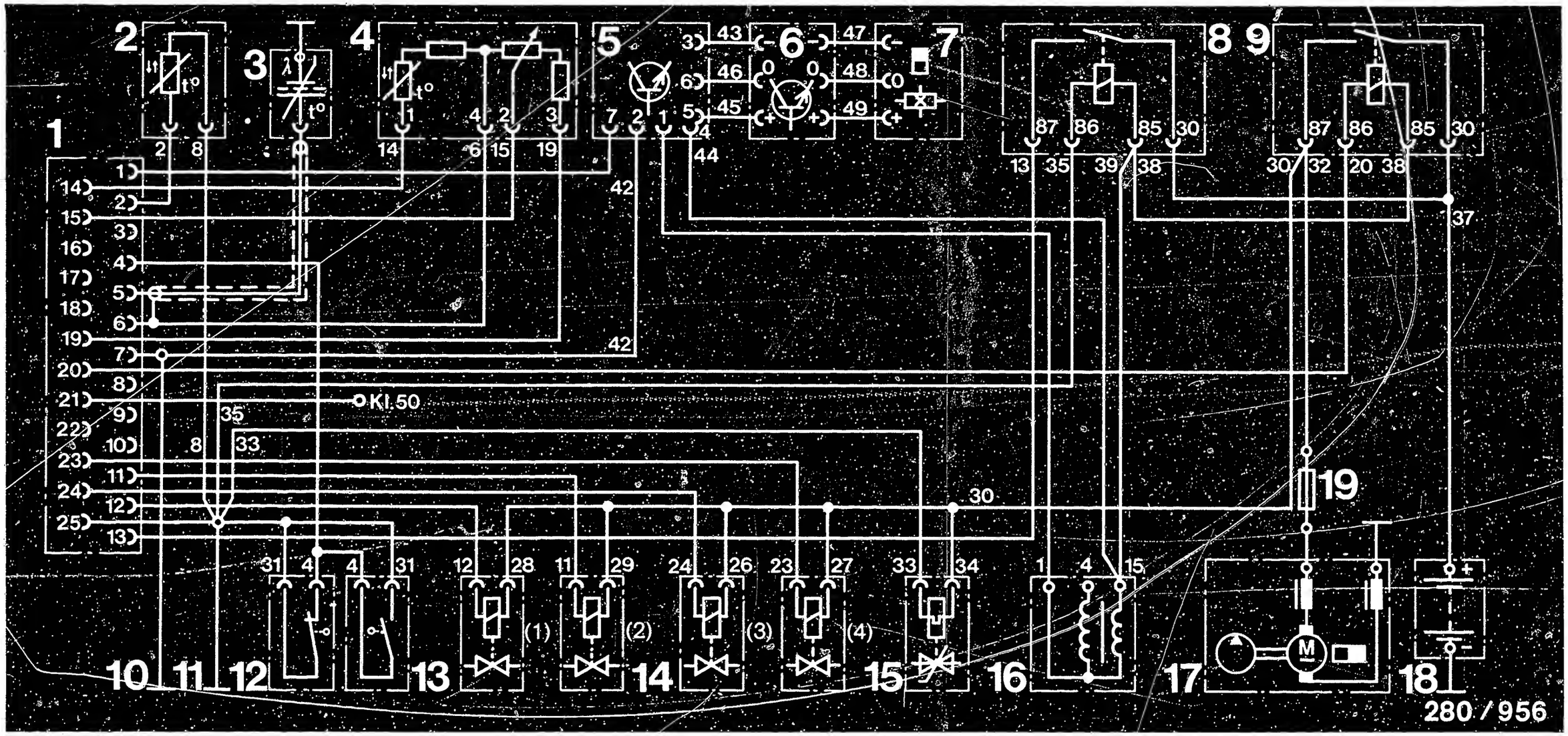
- Europe version 0.8...1.8 vol.%CO
- US version: (CO sampling point on exhaust pipe on left)
  lambda sensor and digital idle stabilization connected: 0.3...1.1 vol.%CO
  Setting with lambda sensor connector taken apart: 0.7 vol. % CO

See equipment and Autodata microfiches for settings for ignition, valve clearance and other engine data.



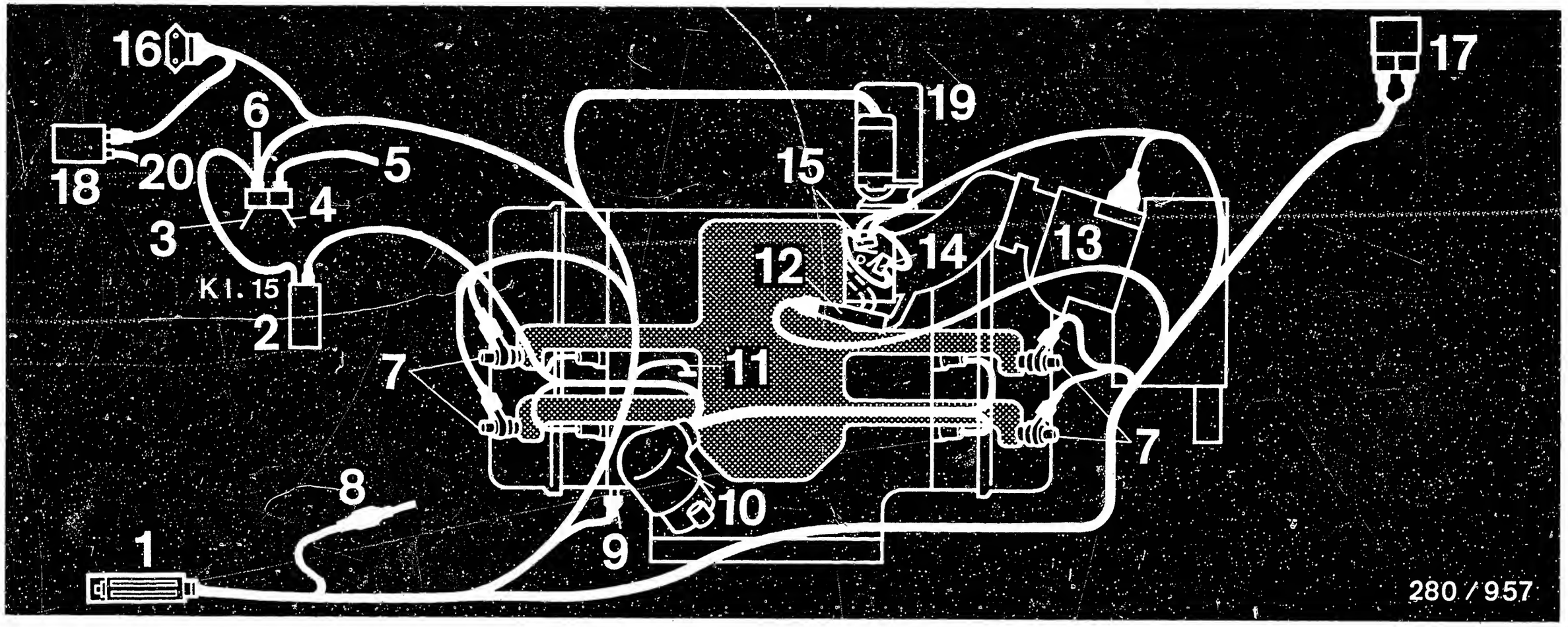
Electrical terminal diagram (EU version)

1 = Control-unit plug
2 = Temperature sensor II
3 = Air-flow sensor
4 = Main relay
5 = Pump relay
6 = Central ground
7 = Full-load switch
8 = Idle switch
9 = Injection valves
10 = Electric fuel pump
11 = Battery
12 = Pump fuse



Electrical terminal diagram (US version)

1 = Control-unit plug
2 = Temperature sensor II (engine)
3 = Lambda sensor
4 = Air-flow sensor
5 = TI trigger box
6 = Digital idle stabilization (DIS)
7 = Ignition pulse generator
8 = Main relay
9 = Pump relay
10 = Electronics ground terminal
11 = Output stage ground
12 = Idle microswitch
13 = Full-load microswitch
14 = Injection valves
15 = Auxiliary-air device
16 = Ignition coil
17 = Electric fuel pump
18 = Battery
19 = Electric fuel pump fuse



Electrical wiring diagram

1 = Control-unit plug
2 = Ignition coil
3 = Main relay
4 = Pump relay
5 = to electric fuel pump
6 = to battery term. 30
7 = Injection valves
8 = Sensor connector (US version only)
9 = Temperature sensor II
10 = Ignition distributor
11 = Ground terminal
12 = Idle actuator or (auxiliary-air device US version only)
13 = Air-flow sensor
14 = Full-load switch
15 = Idle switch
16 = Ignition trigger box
17 = Idle controller (not applicable on US version)
18 = Digital idle stabilization (DIS) (on US version only) EU as of 7.84
19 = Starting motor
20 = to pulse generator (US version)

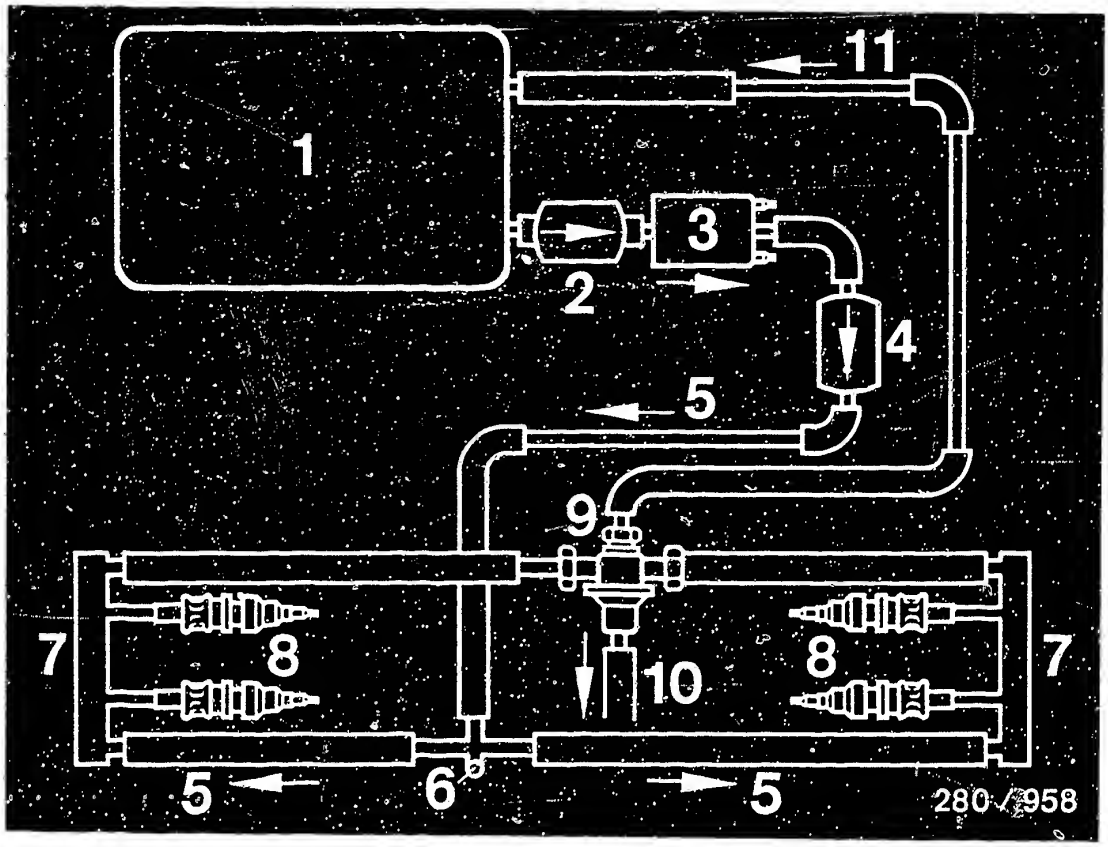
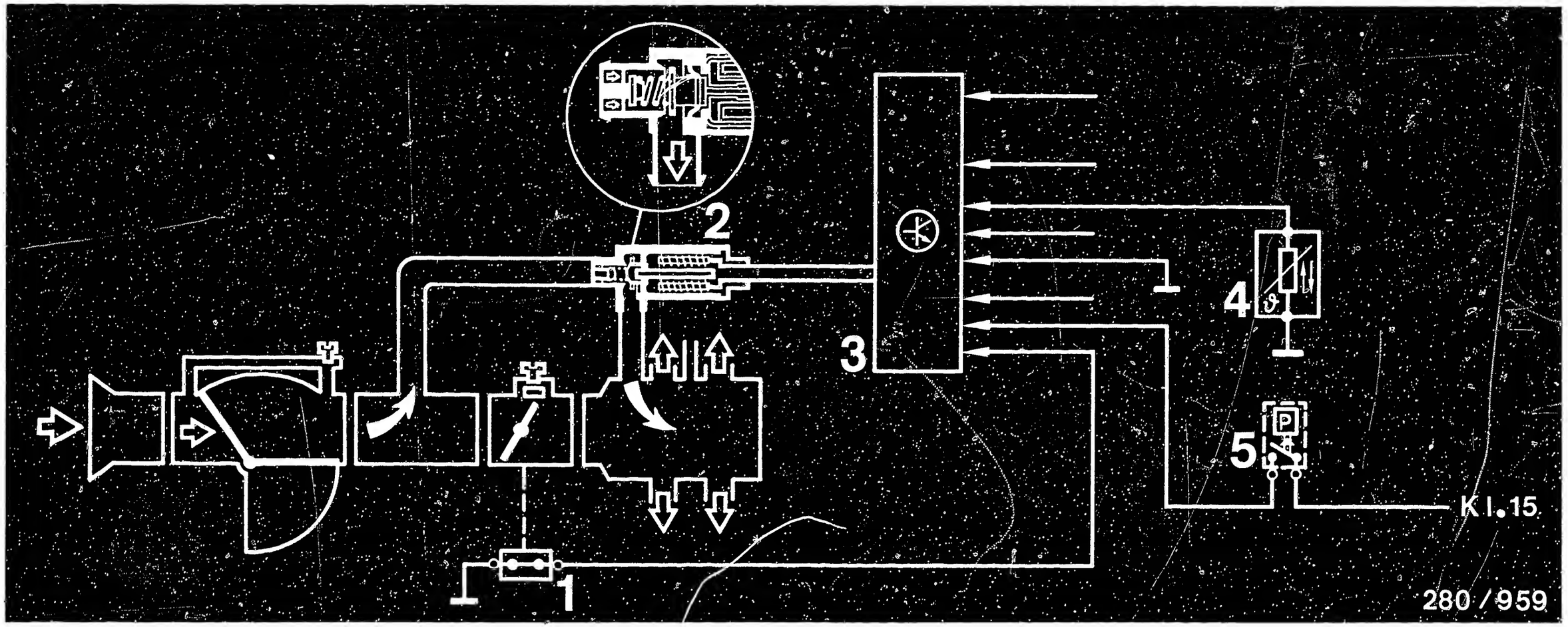


Diagram of fuel lines

1 = Fuel tank
2 = Intake fuel filter (EU)
3 = Fuel pump
4 = Fuel filter (US)
5 = Fuel delivery line
6 = Connection for pressure tester
7 = Fuel-distribution pipe
8 = Injection valves
9 = Pressure regulator
10 = to intake manifold
11 = Fuel return line



Idle-speed control (non-Bosch product)

1 = Idle contact
2 = Idle actuator
3 = Idle controller
4 = Temperature sensor II
5 = Pressure switch (power-assisted steering)

Operating principle: If the engine speed differs from the setpoint stored in the idle controller, the idle actuator is opened/closed more or less as the case may be. This regulates the air flow for operation at idle when the throttle valve is closed. The current engine speed is signalled from terminal 1 of the ignition coil. The control unit makes a comparison. Result: e.g. engine speed too low. The idle controller increases the output current for the idle actuator which is then opened wider, increasing the air throughput and opening the sensor flap. The engine speed rises.
The temperature sensor provides information on the engine operating temperature. Data sensors for engine-speed increase are: pressure switch (for power-assisted steering), A/C switch and starter-immobilization switch on vehicles with automatic transmission when a drive mode is selected.

A18 Idle-speed control
VW Type 25, Carat, Vanagon

A19 Idle-speed control
VW Type 25, Carat, Vanagon

TEST EQUIPMENT AND TOOLS

Description	Designation	Part No.
Universal test adapter	ETT 018.01	0 684 101 801
Adapter lead		1 684 463 156
Motortester	e.g. MOT 002.00 or MOT 300 MOT 400	0 684 000 200 0 684 000 300 0 684 000 400
Exhaust-gas analyzer calibrated analyzers:	e.g. ETT 008.00 ETT 008.04 or ETT 008.05	0 684 100 800 0 684 100 804 0 684 100 805
Test lead		1 684 463 093
Electrics tester or multimeter	e.g. ETE 014.00 e.g. Philips PM 2517 X e.g. Miselco Master 50 K e.g. Fluke Multimeter 75	0 684 101 400
Pressure gauge	Quality class 1.0 = 6 bar 0.1 bar graduations	1 687 231 154
Three-way line		KDJE-P 100/13
Pressure tester or Pressure tester (no longer available)		KDJE-P 100 KDEP 1034

Test equipment and tools (continued)

Description	Designation	Part No.
Clamping fixture		1 688 120 093
Assembly mandrel		1 687 931 003
for US version Exhaust sampling pipe	Screw-type sleeve	V.A.G. 1506
Hexagon-socket-screw key AF 5		commercially available
Solenoid-operated injection valve		0 280 150 206/ 207
Parts set		0 287 010 701

Use suitable, commercially available tools for removing and fitting the idle CO anti-tamper device on the air-flow sensor.

Explanatory remarks on universal test adapter with adapter lead for L2 version
(Part No. 1 684 463 156)

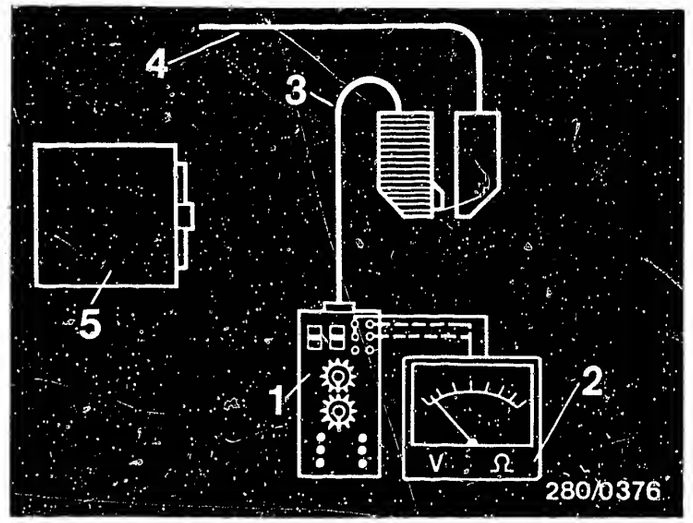
General:

The universal test adapter is connected to the vehicle wiring harness with the adapter lead.

Caution:
Connect and disconnect the universal test adapter only with the ignition off.

Testing:

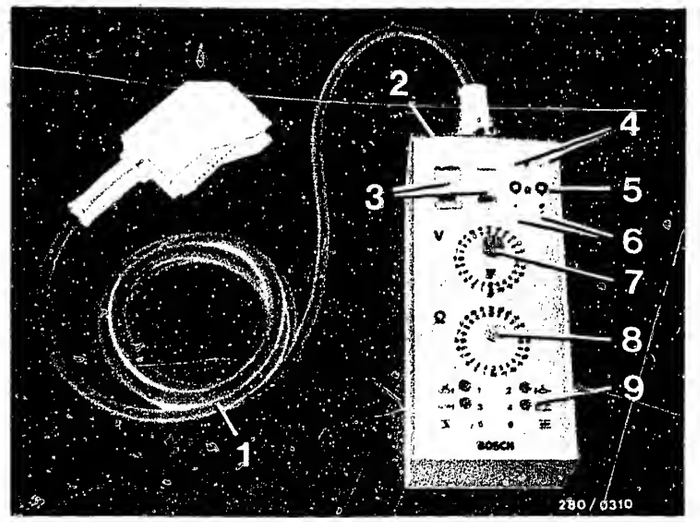
For testing, connect a multimeter with R_i min. 20 kΩ/V to the test adapter.
In addition, the TD signal can be measured with a motortester via the special input.

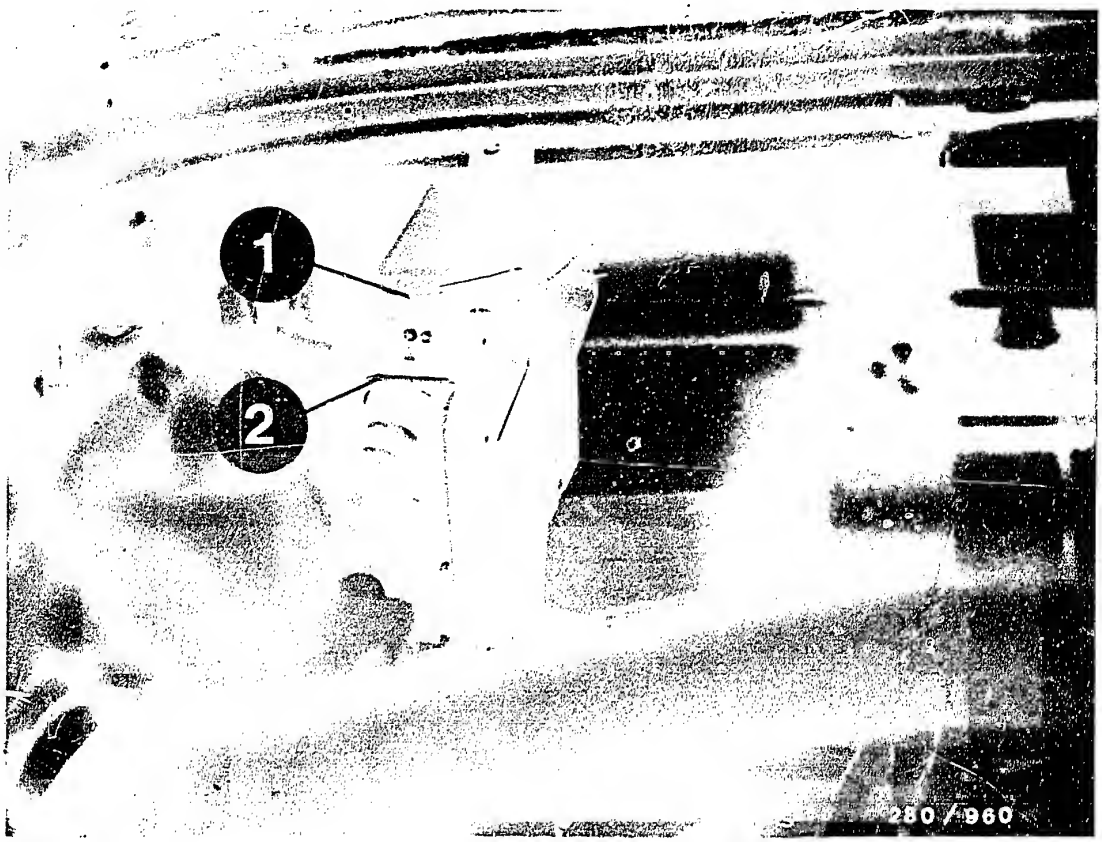


1=Universal test adapter
2=Multimeter
3=Adapter lead (L2 version)
4=Vehicle wiring harness
5=L-Jetronic control unit

Universal test adapter with adapter lead for L2 version

1 = Adapter lead (Part No.: 1 684 463 156)
2 = Universal test adapter (Part No.: 0 684 101 801)
3 = Test wells (for motortester)
4 = Test sockets (for voltage measurement)
5 = Test sockets (for resistance measurement)
6 = Test sockets (not assigned)
7 = Program switch "V"
8 = Program switch "Ω"
9 = Button panel (not assigned for L2 version)





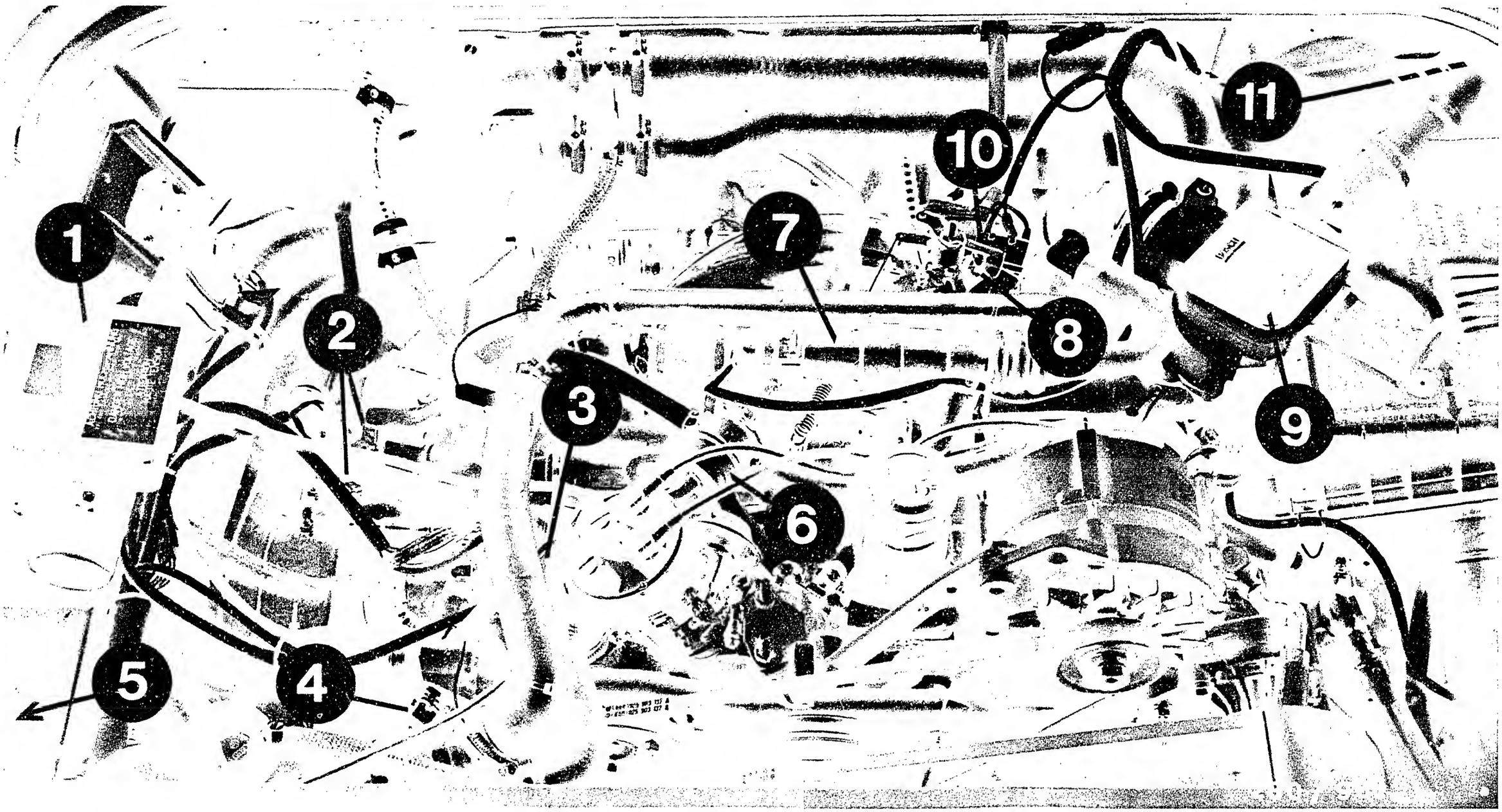
1 = L2 control unit
2 = Locking spring

Installation position of components

The indications "right" and "left" always refer to the forward direction of travel.

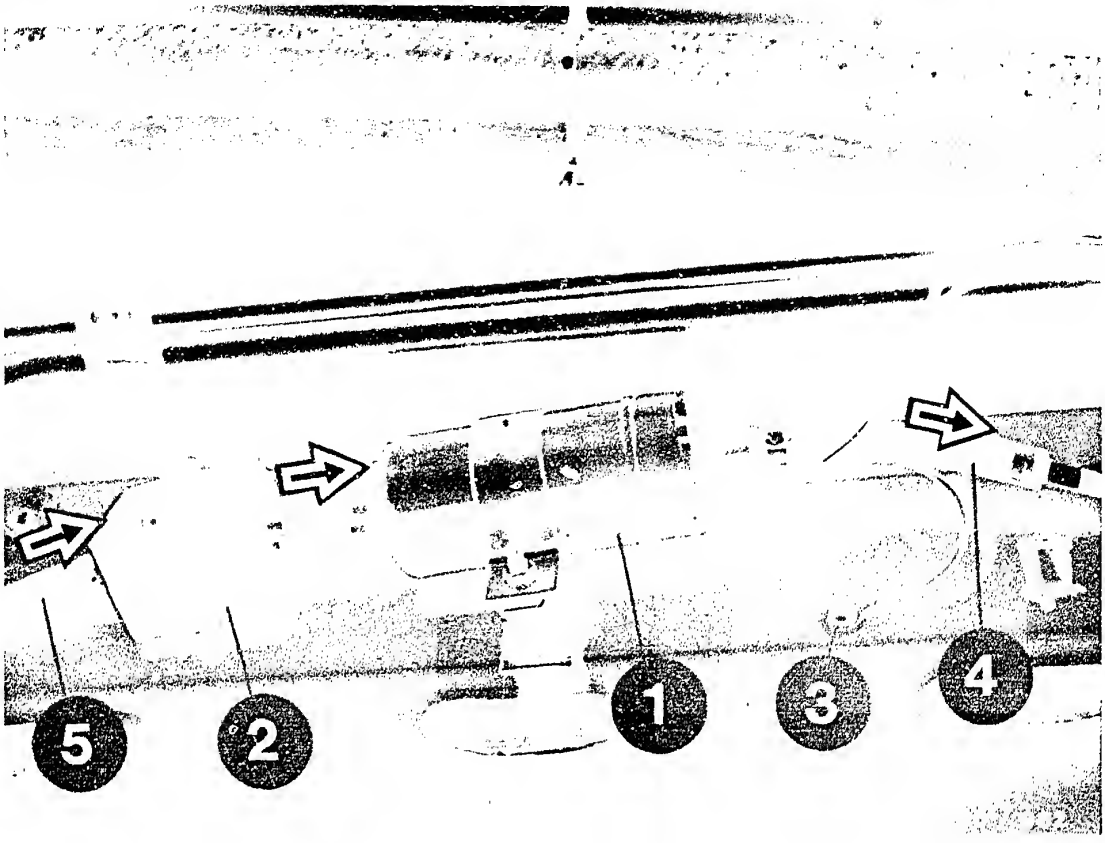
The control unit is in the engine compartment on the left behind the left-hand tail light.

To remove, it is necessary to take out the left-hand tail light. To test, press up the locking spring and hinge the plug downward.



Installation position of components (continued) Europe version (US version similar)

1 = Main relay and pump relay
2 = Injection valves
3 = Central ground
4 = Temperature sensor II
5 = L2 control unit
6 = Pressure regulator
7 = Idle actuator
8 = Full-load switch
9 = Air-flow sensor
10 = Idle switch
11 = Idle controller (behind a cover)



1 = Electric fuel pump
2 = Intake fuel filter
3 = Ground connection (electric fuel pump)
4 = Fuel delivery line
5 = Fuel intake line

Arrow = Direction of fuel flow

No. 2 does not apply to the US version, but there is a fuel filter in the delivery line.

Important general information

- Never start the engine without the battery securely connected.
- Do not use a starting aid with more than 16 V or a fast charger for starting.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- When fast charging the battery, disconnect the battery from the vehicle electrical system.
- Remove the control unit at temperatures above +80°C (paint-drying installation).
- Make sure that all connectors of the wiring harness are securely connected.
- Never disconnect or connect the control-unit plug with the ignition on.
- When testing compression, interrupt the power supply by disconnecting the main relay. In addition, disconnect the plug on the ignition trigger box. This ensures that the power supply to the L-Jetronic (L2 version) and therefore also to the injection valves is interrupted. Undesired injecting is thus prevented.

- Remove the L2 control unit for electrical welding work (e.g. spot welding).

- Follow the information on SIS microcard SIS ALL 500 if an alarm system is installed.

- When using the following trouble-shooting program, it is assumed that the engine is O.K. and that the ignition is correctly adjusted. The electrical system must be checked and, if necessary, repaired.

- In order to carry out the testing operations described in this manual and to assess the components, you should be familiar with the L-Jetronic and how it works.
  The basic points of the operating principle and construction of the L-Jetronic are described in Technical Instruction VDT-U 3/3. The LH version is described in Technical Bulletin, New Product VDT-I-280/4 of 10.83 and .. 280/7 of 12.83.

TROUBLE-SHOOTING CHARTS

Using the universal test adapter with adapter lead (1 684 463 156) and other suitable testers, the following trouble-shooting charts are intended to enable workshop employees to quickly detect the causes of trouble on the L-Jetronic.
Depending on the level of training and experience of the employee, a choice can be made between the following working procedures.

- Detailed, step-by-step trouble-shooting chart

  For employees with little experience or practice on vehicles with L-Jetronic (version L2). The customer complaint always starts off with a complete trouble-shooting program.

C3

- Pin-pointed, direct trouble-shooting chart

  For trained, experienced employees having plenty of practice on vehicles with the L2 version. Trouble-shooting according to customer complaint starts at a specific component within the trouble-shooting program

C5

Both trouble-shooting charts begin by checking the electrical/electronic part of the L2 version with the aid of the universal test adapter with adapter lead. This quickly checks the electrical operation of the wiring harness with the components connected to it, and faults are quickly detected.
If no fault is found with the universal test adapter, carry out the fuel pressure test.

If once again no fault is found, continue with the detailed or direct trouble-shooting chart.

1. Detailed, step-by-step trouble-shooting chart for the complete trouble-shooting program

- Electrical test with universal test adapter, adapter lead 1 684 463 156 and motortester/multimeter
  (Coordinates C9...E3)

- Fuel pressure test with pressure gauge
  This test must come immediately after the test with the universal test adapter and must be performed from beginning to end (Coordinates E4...E15)

- Trouble-shooting according to customer complaints (fault symptoms)
  The table below contains possible fault symptoms and the right-hand column gives the first coordinate of the respective detailed trouble-shooting program.
  This trouble-shooting program consists of logically ordered test procedures for all individual components of the LH version.
  If, after completing the trouble-shooting program for an assumed symptom, the fault has not been detected or eliminated, choose a new fault symptom and work through another program.

Customer complaints (fault symptoms)	Electrical test with universal test adapter	Fuel pressure test with pressure gauge	Trouble-shooting program
1. Starting motor operates, engine fails to start or starts only with great difficulty	C 9	E 4	E 16
2. Engine starts but then dies	C 9	E 4	F 7
3. Rough idle/incorrect idle speed	C 9	E 4	F 19
4. Poor throttle take-up	C 9	E 4	H 1
5. Engine missing under all operating conditions	C 9	E 4	J 5
6. Fuel consumption too high	C 9	E 4	K 7
7. Maximum engine power/top speed not reached	C 9	E 4	L 5
8. Idle speed and CO concentration too low or too high	C 9	E 4	L 17

2. Pin-pointed, direct trouble-shooting chart for components within the trouble-shooting programs

- **Electrical test with the universal test adapter, adapter lead 1 684 463 156 and motortester/multimeter**
  The test with the universal test adapter must come at the start of the test program and be performed from beginning to end (Coordinates C9...E3).

- **Fuel pressure test with pressure gauge**
  The fuel pressure test must come immediately after the test with the universal test adapter and be performed from beginning to end (Coordinates E4...E15).

- **Trouble-shooting according to customer complaints**
  The table below contains various fault symptoms with several possible causes of the trouble in each case. The coordinate reference field indicates the first coordinate of the test procedure for the respective individual component of the L2 version. If, after testing the individual components, the fault has not been detected or remedied, choose a new fault symptom.

Customer complaints (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with great difficulty
2. Engine starts but then dies
3. Rough idle/incorrect idle speed
4. Poor throttle take-up
5. Engine missing under all operating conditions
6. Fuel consumption too high
7. Maximum engine power/top speed not reached
8. Idle speed and CO concentration too low or too high

1	2	3	4	5	6	7	8	Cause (Component fault)
C9	C9	C9	C9	C9	C9	C9	C9	Fault in electrics; test with universal test adapter
E4	E4	E4	E4	E4	E4	E4	E4	Faults in fuel supply. Pressure regulator defective. Pump relay defective. Pump fuse defective. Poor ground connection of electric fuel pump. Electric fuel pump not operating. Fuel pressure test
E22	F9		H7					Auxiliary-air device not opening (US version)
		G1					M7	Auxiliary-air device not closing (US version)
F1	F13	G7	H9	J7	L1	L11	M13	Air-flow sensor defective, test potentiometer (noise test)
	F11				K9		M19	Injection valves leaking

Customer complaints (fault symptoms)

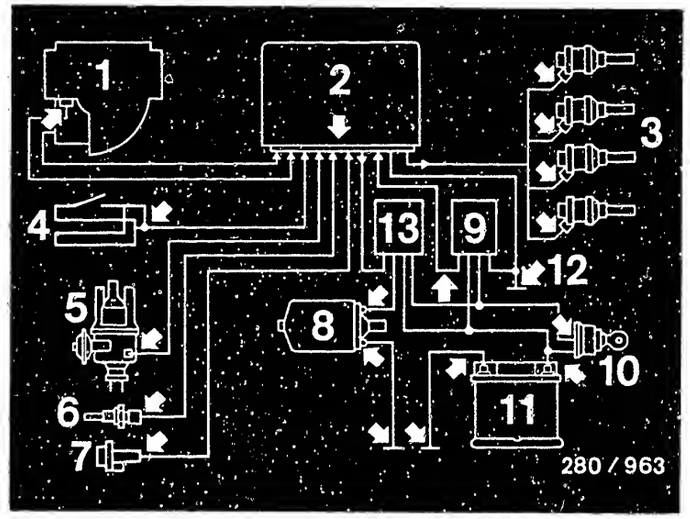
1. Starting motor operates, engine fails to start or starts only with great difficulty	2. Engine starts but then dies	3. Rough idle/incorrect idle speed	4. Poor throttle take-up	5. Engine missing under all operating conditions	6. Fuel consumption too high	7. Maximum engine power/top speed not reached	8. Idle speed and CO concentration too low or too high	Cause (Component fault)
E18							M15	Cold-start control defective
F3	F15	G9	H15			L13	M21	Air-intake system leaking
		G3		J15	K9			Injection valves defective; connect test lead (removal and installation)
				J9		L9		Insufficient fuel delivery from electric fuel pump
		F21	H3	J11				Throttle valve not closing (check overrun cutoff)
						L7		Throttle valves not opening fully (full-load switch defective)
		F23	H5			L7		Throttle actuation incorrectly adjusted
		G11	H17		K13		L19	CO exhaust-gas setting too rich, idle adjustment
		G11	H17	J19			L19	CO exhaust-gas setting too lean, idle adjustment, coughing
				J11		L7		Control unit defective
			J1	K3	K23		M3	Lambda closed-loop control defective (US version)
				J7				Interference, voltage peaks
				J11				Coughing in the exhaust
							M9	Idle stabilization defective

Test chart for universal test adapter with connected adapter lead 1 684 463 156 for L2 version in VW Type 25 Vanagon (US version) as of 1.83 and VW Type 25 Carat 10.83 (EU version)

- Before testing with the universal test adapter, check all multiple plug connections for loose contacts.
  Clean plug contacts if dirty or corroded.
- Watch for receptacles that have been pushed back.
  If necessary, bend back locking tab and press receptacle into plug housing as far as it will go. Locking tab latches.
- Suspicion of breaks in lead if kinked or pinched.
  Installation position of control unit: in engine compartment on left behind left-hand tail lamp. Removing the control unit: left-hand tail lamp must be removed.
  The universal test adapter tests only the peripherals of the electrics (not including control unit).
  Disconnect control-unit plug of Jetronic wiring harness from control unit and connect to plug of adapter lead (ignition must be off). Connect a multimeter for voltage and resistance measurement as well as a motortester to the universal test adapter in order to take the readings. The individual test steps are selected by means of two program switches (one for voltage measurements and the other for resistance measurements). Each program switch as 24 test settings, only some of which, however, are assigned for the L2 version.
  If a fault is found during a test, the test must be repeated after the fault has been eliminated.

  The test with the universal test adapter must always be performed from beginning to end.
  Be sure to follow the instructions in the test chart.
- Test steps 1 ... 4 measure voltages while starting. Set multimeter to "voltage measuring range".
- Test steps 5 ... 14 measure resistances.
  Set multimeter to "resistance measuring range".

  Test specifications and notes on how to operate the universal test adapter are given in the following test chart.



Electrical plug connections (arrows)
1 =Air-flow sensor
2 =Control unit
3 =Injection valves
4 =Microswitches (Idle and full load)
5 =Ignition distributor
6 =Temperature sensor II (engine)
7 =Auxiliary-air device/US version only
8 =Electric fuel pump
9 =Main relay
10=Ignition lock
11=Battery
12=Central ground
13=Pump relay

Requirements for correct testing procedure:

1. Start testing at test step 1.

2. The sequence of test steps must be kept to.
The trouble-shooting for one test step builds on the trouble-shooting for the last test step.
Example: When, in test step 1, the ground connection term. 7 for the control unit is tested, this test is not repeated in the following test steps.

3. If an incorrect reading is indicated for a test step, this test step must be repeated after the fault has been remedied.

Note:
In the following test steps a white border in the "Operation" column indicates which operation has to be changed in comparison with the preceding test step.

TEST STEP 1

Operation		Reading	Testing
Program switch "V" at position:	4	Measuring equipment must indicate 8 ... 15 V.	Component: Starting motor
Program switch "Ω" at:	*		
Measuring equipment: Motor-tester or multimeter (volt range)			Operation: Starting signal from term. 50. On control-unit plug between term. 21 and term. 7
Measuring range: 0 ... 15 V		yes ↓ Continue testing with next test step	no ↓
Connection: Test sockets, red (positive) and black (negative)			Malfunction: No voltage reading
Operation in vehicle: Ignition "ON" and start			

* Switch position not specified

Trouble-shooting:

For all voltage measurements:
1. Set value 8 ... 15 V (starting)
2. Measure at the respective component plug.
3. The plugs remain connected on the main relay and the pump relay.

For resistance measurements:
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary. Set value approx. 0 Ω.
Important! Ignition "OFF" and measure carefully into the terminals.

Continued on C14/C15

TEST STEP 1 (continued)

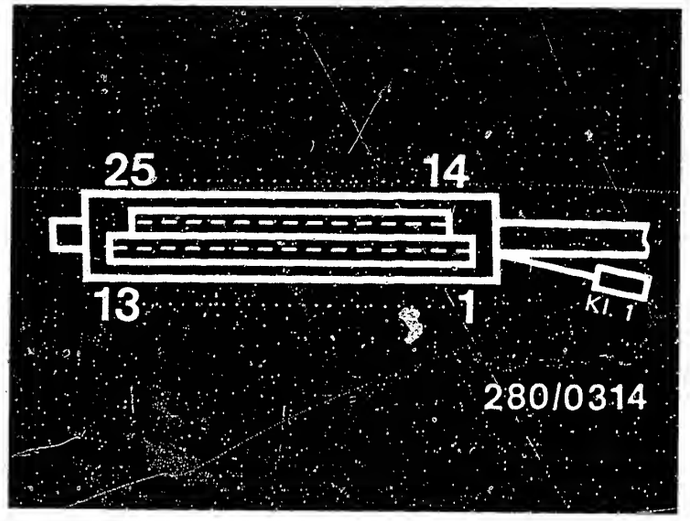
Voltage reading below 8 V:
Battery insufficiently charged or high voltage drops.

No voltage reading:
1. Voltage at control-unit plug term. 21? (Start engine) If no voltage, check lead to starting motor term. 50.
Check ground connection from control-unit plug term. 7 to central ground.

Eliminate contact resistances in the plug-in connections.
If still no voltage reading - check starting system.
Spring contacts must not allow themselves to be pushed back.

Installation position of components:

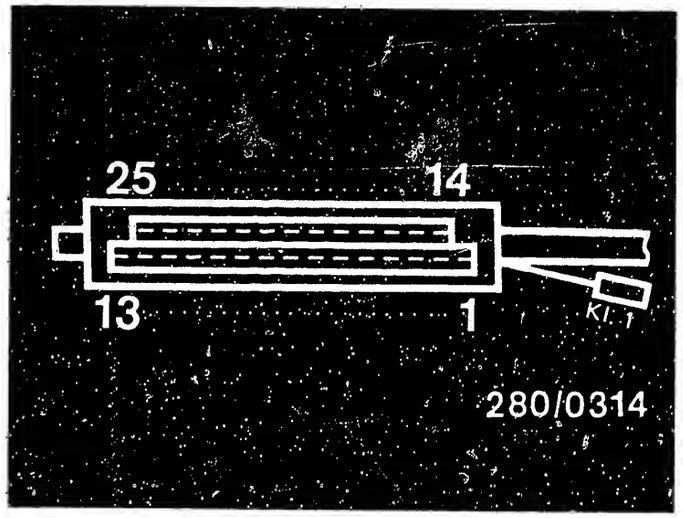
Central ground: On left-hand cylinder head at top.



Top view of control-unit plug

TEST STEP 2

Operation		Reading	Testing
Program switch "V" at position:	5	TD signal see bottom diagram	Component: Ignition trigger box
Program switch "Ω" at position:	-		Operation: Triggering of control unit by TD signal. On control-unit plug between term. 1 and term. 7
Measuring equipment: Ignition oscilloscope		yes ↓ Continue testing with next test step.	Malfunction: No signal or signal incorrect
Measuring range: 20 V			
Connection: Special input			
Operation in vehicle: Ignition "ON" and start		no	

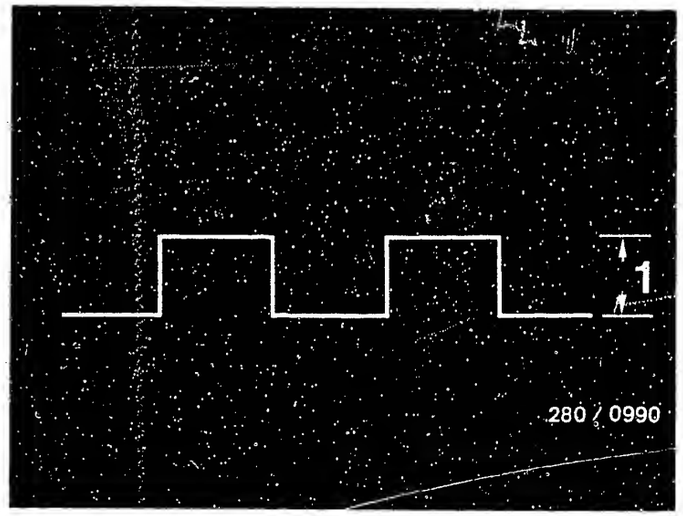


Top view of control-unit plug

Trouble-shooting:

For voltage measurement:
1. Set value 2 ... 8 V (start)
2. Measure at the respective component plug.
3. The plugs remain connected on the main relay and the pump relay.

Continued on C18/C19



1=approx. 10 V

TEST STEP 2 (continued)

For resistance measurements:
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary. Set value approx. 0 Ω.

Important! Ignition "OFF" and measure carefully into the terminals.

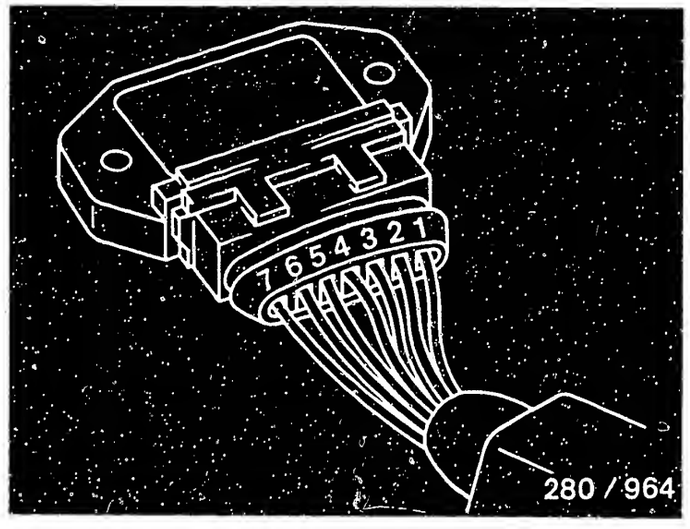
- Square-wave pulse (TD signal) at TI trigger box term. 7? (Start engine).
  (Connect special input of motortester between term. 7 and ground on TI trigger box).

  No - check ignition system.

  Yes - check lead from control-unit plug term. 1 and TI trigger box term. 7 for continuity.

- If lead O.K., trigger stage in control unit has failed.
  Replace control unit.

Installation position of components:
TI control unit: in engine compartment on left on firewall.



TI control unit (plug)

TEST STEP 3

Operation	Reading	Testing
Program switch "V" at position: 6	Measuring equipment must indicate 8 ... 15 V	Component: Main relay
Program switch "Ω" at position: -		
Measuring equipment: Motor-tester or multimeter (volt range)	yes ↓ Continue testing with next test step.	Operation: Power supply from term. 87 main relay. On control-unit plug between term. 13 and term. 7
Measuring range: 0 ... 15 V		
Connection: Test sockets, red (positive) and black (negative)	no ↓	Malfunction: No voltage reading
Operation in vehicle: Ignition "ON"		

Trouble-shooting:

For all voltage measurements:
1. Set value 8 ... 15 V
2. Measure at the respective component plug.
3. The plugs remain connected on the main relay and the pump relay.

For resistance measurements:
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary. Set value approx. 0 Ω.
Important! Ignition "OFF" and measure carefully into the terminals.

Continued on C22/C23

TEST STEP 3 (continued)

Measure voltage (set value 8...15 V), ignition "ON".

- Voltage at main relay base term. 85?

  No - 1. Check lead from term. 85 main relay to term. 85 pump relay for continuity.
  2. Check lead from term. 85 pump relay to ignition coil term. 15 for continuity.

  Yes- Check ground lead from main relay term. 86 to central ground for continuity.

- Voltage at main relay base term. 30?

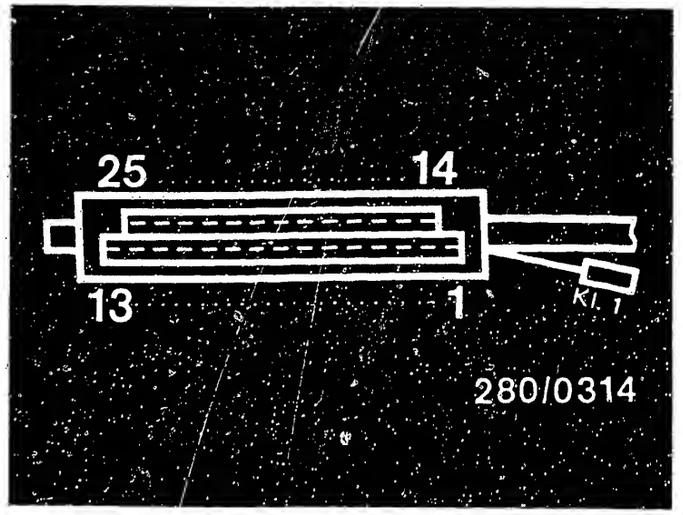
  No - Check lead from term. 30 main relay to positive battery terminal (disconnect battery) for continuity.

  Yes- No voltage at term. 87 main relay - check lead term. 87 main relay to control-unit plug term. 13 for continuity.

  Lead O.K.?

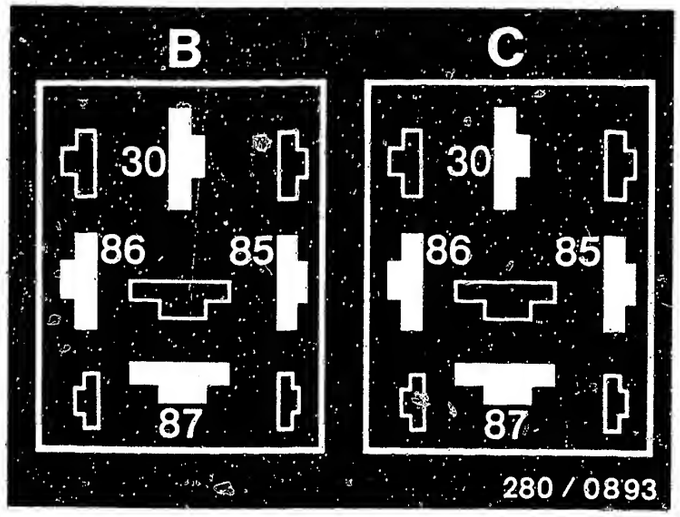
  Yes- Replace main relay.

Installation position of components
Main relay and pump relay: in engine compartment on left in a box (main relay on left and pump relay on right).
Ignition coil: in engine compartment on left under relay box.
Central ground: on left-hand cylinder head at top.



Top view of control-unit plug

Main relay (B) and pump relay (C) disconnected
Top view of plugs



TEST STEP 4

Operation		Reading	Testing
Program switch "V" at position:	7	Measuring equipment must indicate 8 ... 15 V	Component: Pump relay
Program switch "Ω" at position:	-		
Measuring equipment: Motortester or multimeter (volt range)		yes ↓ Continue testing with next test step.	Operation: Ground supply from term. 20 to pump relay. On control-unit plug between term. 20 and term. 7
Measuring range: 0 ... 15 V			
Connection: Test sockets, red (positive) and black (negative)			Malfunction: No voltage reading
Operation in vehicle: Ignition "ON"		no ↓	

Trouble-shooting:

For all voltage measurements:
1. Set value 8 ... 15 V
2. Measure at the respective component plug.
3. The plugs remain connected on the main relay and the pump relay.

For resistance measurements:
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary. Set value approx. 0 Ω.
Important! Ignition "OFF" and measure carefully into the terminals.

Continued on D3/D4

TEST STEP 4 (continued)

Measure voltage (set value 8...15 V), ignition "ON"

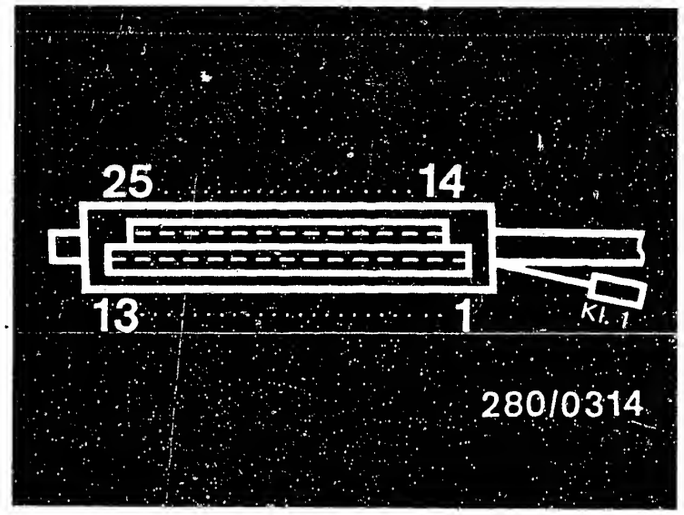
- Voltage at pump relay base term. 85?

  No - Check lead from term. 85 pump relay to ignition coil term. 15 for continuity.
  Yes - Check lead from pump relay term. 86 to control-unit plug term. 20 for continuity.

  Lead O.K. - 1. Replace pump relay.
  2. Replace control unit.

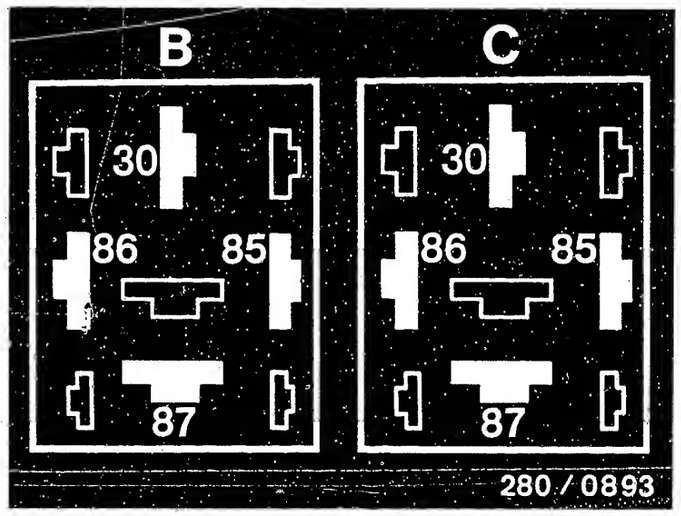
Installation position of components

Pump relay: In engine compartment on left in a box (right-hand relay)
Ignition coil: In engine compartment on left under the relay box.

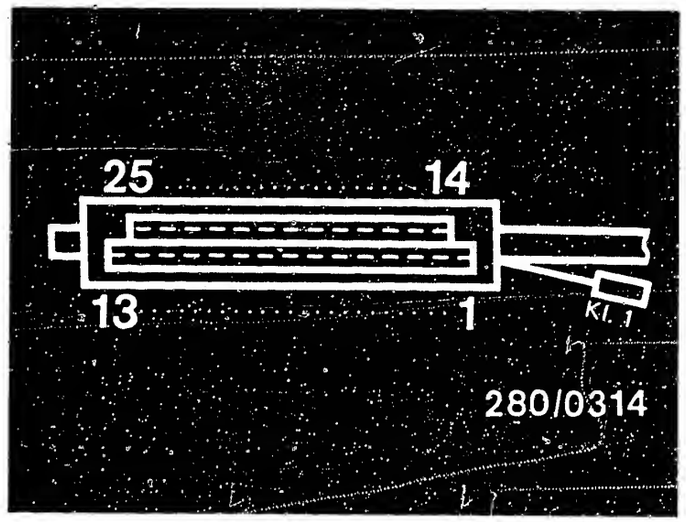


Top view of control-unit plug

Main relay (B) and pump relay (C) disconnected.
Top view of plugs.



TEST STEP 5 Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 1.45 ... 3.3 kΩ at ambient temperature (+15°C...+30°C) 280...360 Ω with engine at op.temp. (approx. +80°C).	Component: Temperature sensor II (engine)
Program switch "Ω" at position:	5		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 2 and term. 7 (ground)
Measuring range: x 10 Ω or x 100 Ω			
Connection: Blue test sockets		yes → Continue testing with next test step.	Malfunction: Resistance not within tolerance
Operation in vehicle: -----		no →	



Top view of control-unit plug

Installation position of components:
Engine temperature sensor: in cooling-water circuit at front left on engine block.
Central ground: on left-hand cylinder head at top.

Trouble-shooting:

For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.
Measure resistance directly at temperature sensor II (engine) blue.

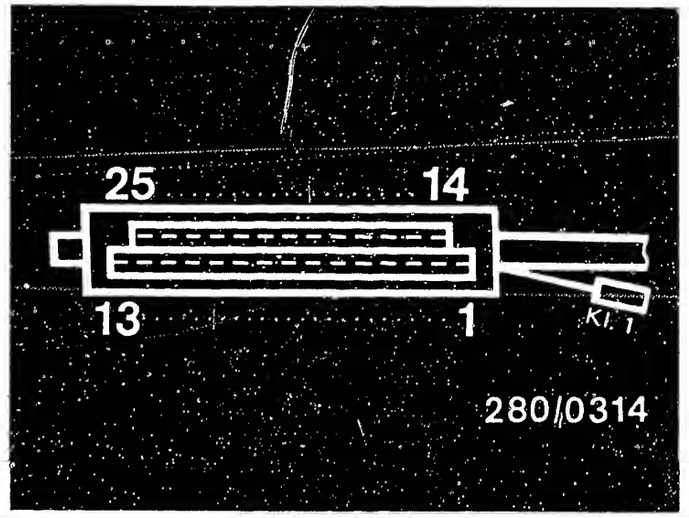
At ambient temperature (approx. +15°C...+30°C):	1.45 ... 3.3 kΩ
Engine at op. temp. (approx. +80°C):	280 ... 360 Ω

Check the following leads for continuity with ohmmeter (Set value approx. 0Ω):
- From control-unit plug term. 2 to temperature sensor II (engine) term. 2
- Lead 8 from temperature sensor II to central ground.

Eliminate contact resistances in the plug-in connections

TEST STEP 6

Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 1.45 ... 3.3 kΩ at ambient temperature (+15°C...+30°C) 280...360 Ω with engine at op. temp. (approx. +80°C).	Component: Temperature sensor I (intake air) in air-flow sensor
Program switch "Ω" at position:	6		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 14 and term. 7 (ground)
Measuring range: x 10 Ω or x 100 Ω		yes → Continue testing with next test step.	no → Malfunction: Resistance not within tolerance
Connection: Blue test sockets			
Operation in vehicle: -----			



Top view of control-unit plug

Installation position of components:
Air-flow sensor: on right between air filter and intake manifold
Central ground: on left-hand cylinder head at top

Trouble-shooting:

For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.
Measure resistance directly at temperature sensor I (intake air) in air-flow sensor.
At ambient temperature (approx. +15°C...+30°C): 1.45...3.3 kΩ
Engine at op. temp. (approx. +80°C): 280 ... 360 Ω

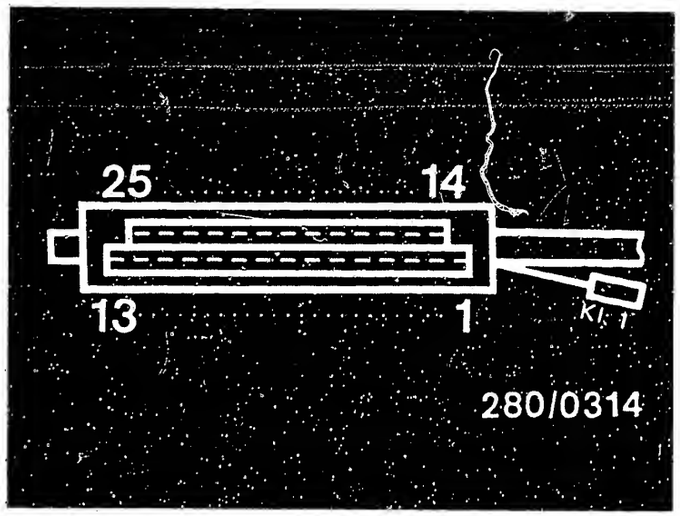
Check the following leads for continuity with ohmmeter (Set value approx. 0 Ω):

- From control-unit plug term. 14 to air-flow sensor term. 1
- From air-flow sensor term. 4 to control-unit plug term. 6

Eliminate contact resistances in the plug-in connections.

TEST STEP 7

Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 8 ... 1000 Ω	Component: Air-flow sensor (potentiometer)
Program switch "Ω" at position:	7		
Measuring equipment: Motortester or multimeter (Ω range)		yes → Continue testing with next test step.	Operation: Resistance at control-unit plug between term. 15 and term. 7 (ground)
Measuring range: x 10 Ω			
Connection: Blue test sockets			
Operation in vehicle: Deflect air-flow sensor flap as far as it will go.		no ↓	Malfunction: Resistance not within tolerance



Top view of control-unit plug

Installation position of components:
Air-flow sensor: on right between air filter and intake manifold.

Trouble-shooting:

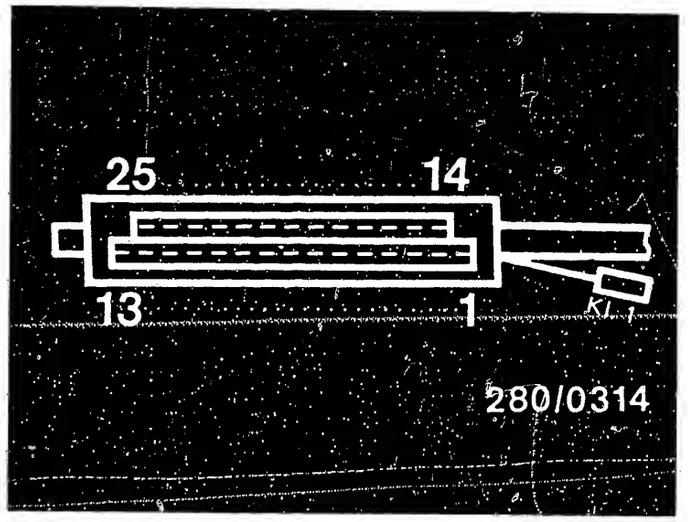
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.
Check the following leads for continuity with ohmmeter (set value approx. 0 Ω):

- From control-unit plug term. 15 to air-flow sensor term. 2
- From air-flow sensor term. 3 to control-unit plug term. 19

Eliminate contact resistances in the plug-in connections.

TEST STEP 8

Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 500 ... 800 Ω	Component: Air-flow sensor
Program switch "Ω" at position:	8		
Measuring equipment: Motortester or multimeter (Ω range)		yes ↓ Continue testing with next test step.	Operation: Resistance at control-unit plug between term. 19 and term. 7 (ground).
Measuring range: x 10 Ω			
Connection: Blue test sockets		no ↓	Malfunction: Resistance not within tolerance
Operation in vehicle: -----			



Top view of control-unit plug

Installation position of components:
Air-flow sensor:
On right between air filter and intake manifold.
Central ground: on left-hand cylinder head at top.

Trouble-shooting:

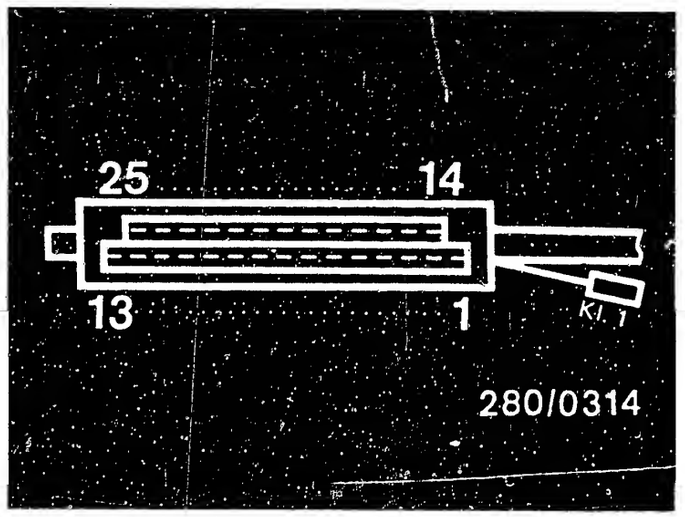
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.
Check the following leads for continuity with ohmmeter (set value approx. 0 Ω):

Air-flow sensor
- From control-unit plug term. 19 to air-flow sensor term. 3
- From air-flow sensor term. 4 to control-unit plug term. 6
- From control-unit plug term. 6 to control-unit plug term. 7

Eliminate contact resistances in the plug-in connections.

TEST STEP 9

Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 1. 0 ... 10Ω (idle) 2. ∞ Ω (part load) 3. 0 ... 10 Ω (full load)	Component: Microswitch Idle contact and full-load contact
Program switch "Ω" at position:	9		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 4 and term. 7 (ground)
Measuring range: x 1 Ω		yes ↓ Continue testing with next test step.	no ↓ Malfunction: Resistance not within tolerance
Connection: Blue test sockets			
Operation in vehicle: 1. Accelerator in rest pos'n 2. Accelerator in part-load pos 3. Accelerator in full-load pos			



Top view of control-unit plug

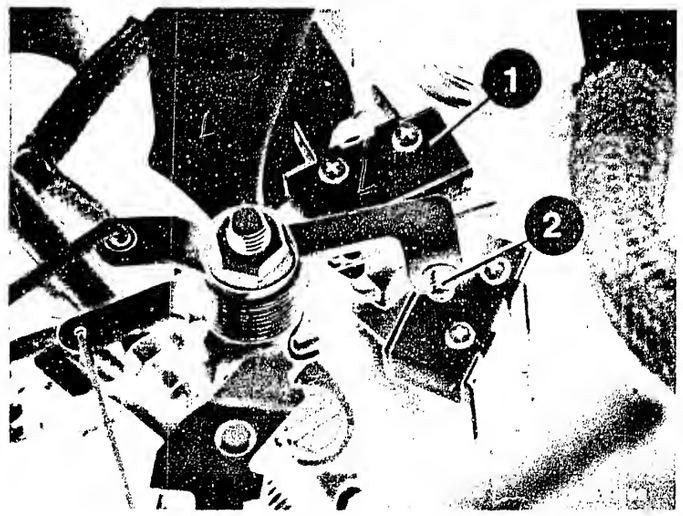
Trouble-shooting:

For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.
Throttle valve closed? Check whether the throttle valve can be closed still further (hair's breadth gap).

Adjusting: Idle switch (1)
- Throttle valve closed
- Adjust adjusting screw (3) so that the switching point is just obtained. From this point, screw in the adjusting screw by one turn.
- Lock the adjusting screw (paint).

Checking the idle switch
- From control-unit plug term. 4 to idle switch connecting lead 4
- From idle switch connecting lead 31 to central ground.

Continued on D15/D16



1=Idle switch
2=Adjusting screw

TEST STEP 9 (continued)

Adjusting the full-load switch

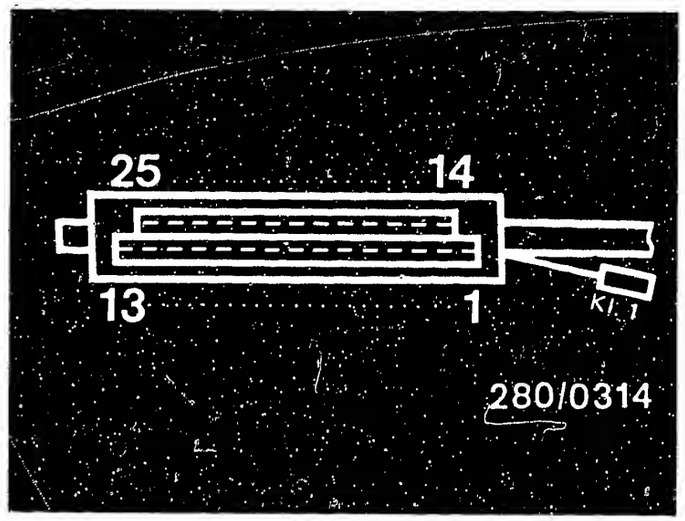
- Loosen fastening screws for switch.
- Fully open throttle valve and move switch until the switching point is obtained. The roller should be approximately in the middle of the cam plate (arrow).
- Tighten fastening screws for full-load switch.

Checking the full-load switch

- Connecting leads of full-load switch are connected parallel to idle switch.

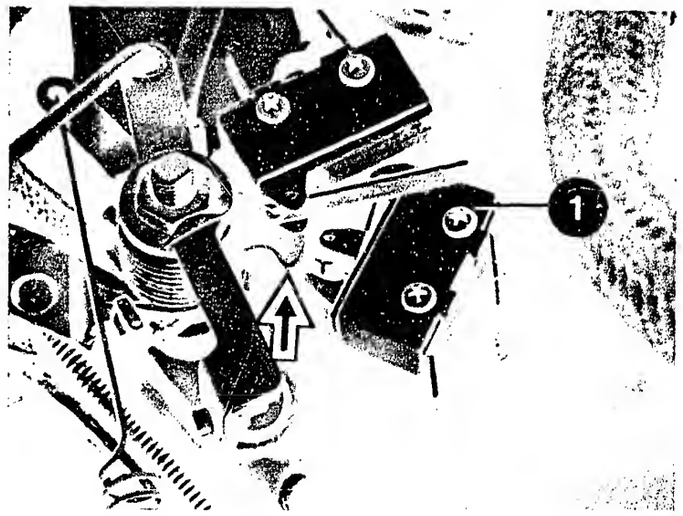
Installation position of components

Idle and full-load switches: on throttle-valve assembly, near air-flow sensor
Central ground: on left-hand cylinder head at top.



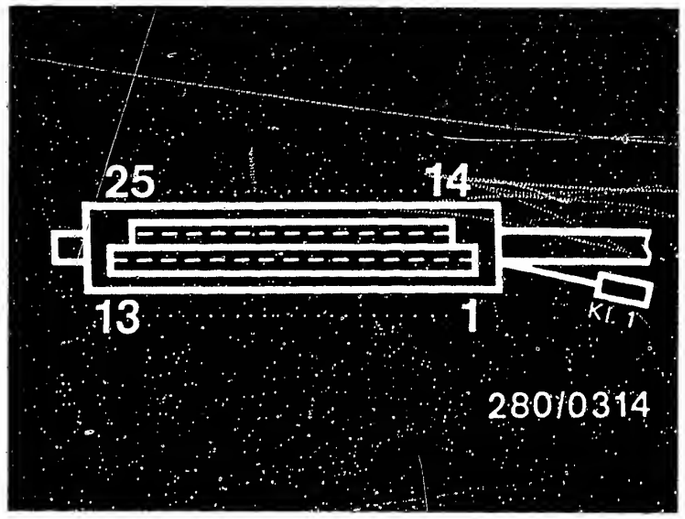
Top view of control-unit plug

1=Full-load switch
Arrow=Cam plate



TEST STEP 10

Operation		Reading	Testing
Program switch "V" at position:	⬇	Measuring equipment must indicate 0 ... 10 Ω	Component: Ground connection of output stage
Program switch "Ω" at position:	11		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Ground connection of control unit Resistance at control-unit plug between term. 25 and term. 7 (ground)
Measuring range: x 1 Ω		yes ⬇ Continue testing with next test step.	no ⬇ Malfunction: Resistance not within tolerance
Connection: Blue test sockets			
Operation in vehicle: ------			



Top view of control-unit plug

Installation position of components:
Central ground: on left-hand cylinder head at top.

Trouble-shooting:

For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.

Check the following leads for continuity with ohmmeter (set value approx. 0Ω):

- From control-unit plug term. 25 to central ground

Eliminate contact resistances in the plug-in connections.

TEST STEP 11

Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 14 ... 24.0 Ω at ambient temperature (+15°...+30°C) 16 ... 26.5 Ω at +80°C.	Component: Solenoid-operated injection valve 1 and electric fuel pump
Program switch "Ω" at position:	12		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 12 and term. 7 (ground)
Measuring range: x 1 Ω		yes ↓	Malfunction: Resistance not within tolerance.
Connection: Blue test sockets		Continue testing with next test step.	
Operation in vehicle: -----			

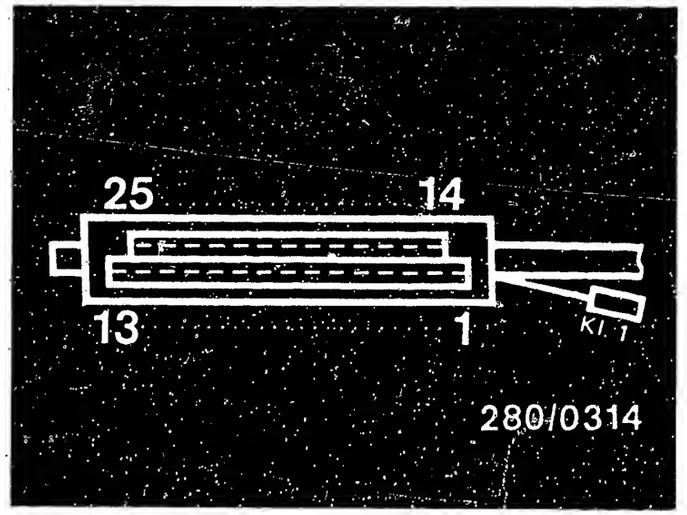
no ↓

Trouble-shooting:

For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.

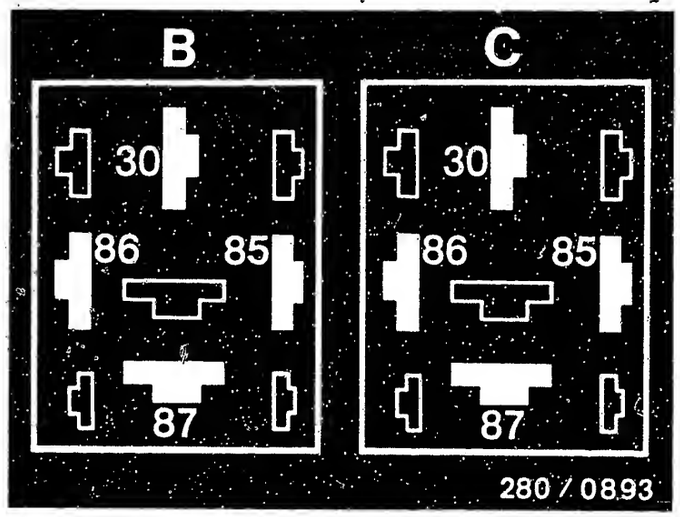
Check the following leads for continuity with ohmmeter (set value approx. 0Ω):

- From control-unit plug term. 12 to solenoid-operated injection valve No. 1
- From solenoid-operated injection valve No. 1, in engine compartment at rear left, to pump relay term. 87
- From pump relay term. 87 to electric fuel pump (unter vehicle on right) (positive terminal) and from negative terminal to ground terminal (right-hand pillar under vehicle)
- Resistance measurement at solenoid-operated injection valve No. 1
  Ambient temperature (+15°C...+30°C): 15 ... 17.5 Ω
  Engine at op. temp. (+80°C): 17 ... 20.0 Ω
- Check plug-in tabs for security.



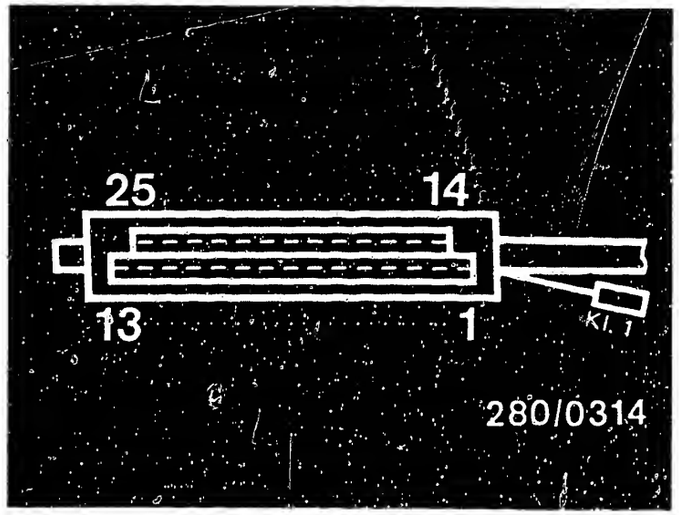
Top view of control-unit plug

Main relay (B) and pump relay (C) disconnected.
Top view of plugs
Installation position in engine compartment on left in a box (pump relay on right)



TEST STEP 12

Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 14 ... 24.0 Ω at ambient temperature (+15°...+30°C) 16 ... 26.5 Ω at +80°C).	Component: Solenoid-operated injection valve 2 and electric fuel pump
Program switch "Ω" at position:	13		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 11 and term. 7 (ground)
Measuring range: x 1 Ω		yes ↓ Continue testing with next test step.	
Connection: Blue test sockets		no ↓	Malfunction: Resistance not within tolerance.
Operation in vehicle: -----			



Top view of control-unit plug

Trouble-shooting:

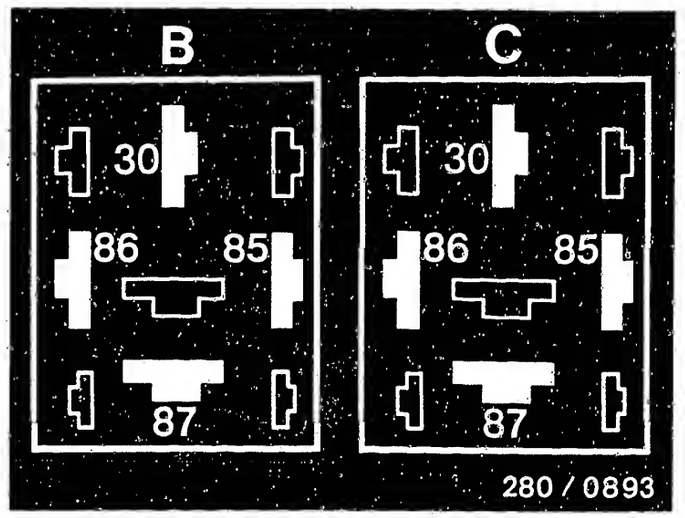
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.

Check the following leads for continuity with ohmmeter (set value approx. 0Ω):

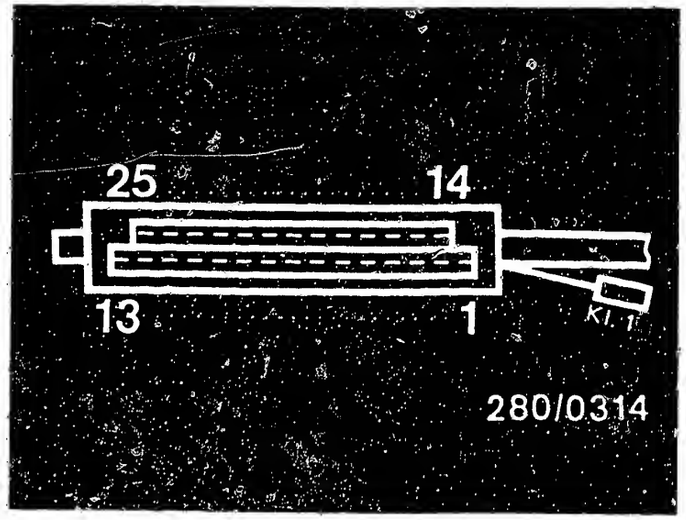
- From control-unit plug term. 11 to solenoid-operated injection valve No. 2
- From solenoid-operated injection valve No. 2 to pump relay term. 87
- Resistance measurement at solenoid-operated injection valve No. 2
  Ambient temperature (+15°C...+30°C): 15 ... 17.5 Ω
  Engine at op. temp. (+80°C): 17 ... 20.0 Ω
- Check plug-in tabs for security.

Installation position of components:
Solenoid-operated injection valve 2: in engine compartment at front left
Pump relay: in engine compartment on left in a box (right-hand relay).

Main relay (B) and pump relay (C) disconnected.
Top view of plugs



TEST STEP 13			
Operation		Reading	Testing
Program switch "V" at position:		Measuring equipment must indicate 14 ... 24.0 Ω at ambient temperature (+15°...+30°C) 16 ... 26.5 Ω at +80°C.	Component: Solenoid-operated injection valve 3 and electric fuel pump
Program switch "Ω" at position:	14		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 24 and term. 7 (ground)
Measuring range: x 1 Ω		yes: Continue testing with next test step.	
Connection: Blue test sockets			Malfunction: Resistance not within tolerance.
Operation in vehicle: -----			



Top view of control-unit plug

Trouble-shooting:

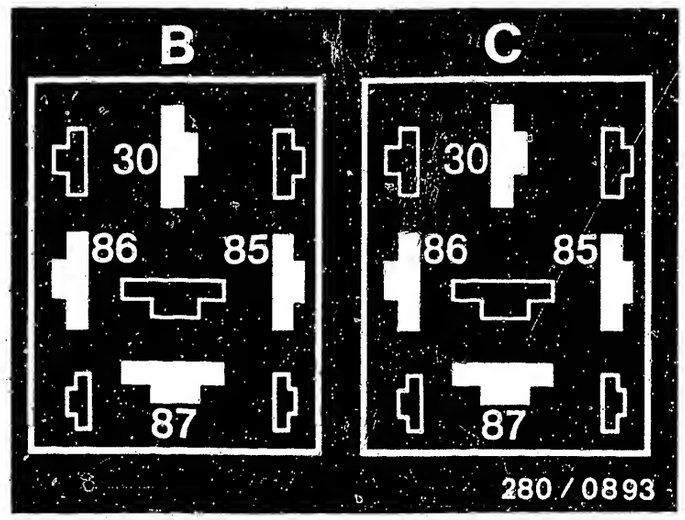
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.

Check the following leads for continuity with ohmmeter (set value approx. 0Ω):

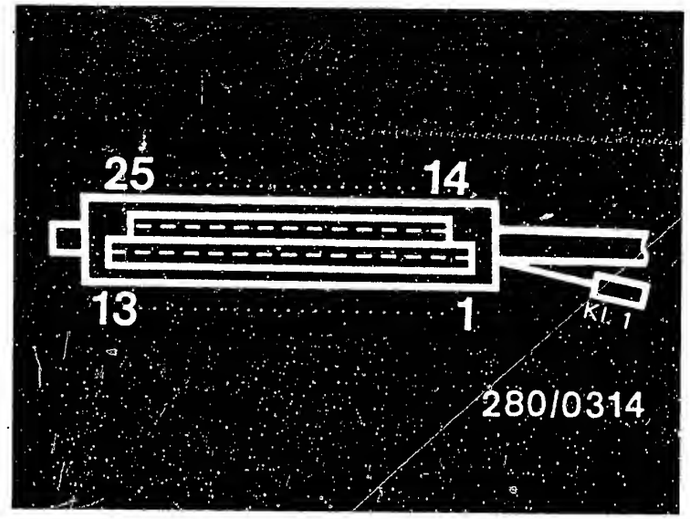
- From control-unit plug term. 24 to solenoid-operated injection valve No. 3
- From solenoid-operated injection valve No. 3 to pump relay term. 87.
- Resistance measurement at solenoid-operated injection valve No. 3
  Ambient temperature (+15°C...+30°C): 15 ... 17.5 Ω
  Engine at op. temp. (+80°C): 17 ... 20.0 Ω
- Check plug-in tabs for security.

Installation position of components:
Solenoid-operated injection valve 3: in engine compartment at front right
Pump relay: in engine compartment on left in a box (right-hand relay)

Main relay (B) and pump relay (C) disconnected.
Top view of plugs



TEST STEP 14			
Operation		Reading	Testing
Program switch "V" at position:	↓	Measuring equipment must indicate 14 ... 24.0 Ω at ambient temperature (+15°...+30°C) 16 ... 26.5 Ω	Component: Solenoid-operated injection valve 4 and electric fuel pump
Program switch "Ω" at position:	15		
Measuring equipment: Motortester or multimeter (Ω range)			Operation: Resistance at control-unit plug between term. 23 and term. 7 (ground)
Measuring range: x 1 Ω		yes ↓	no ↓
Connection: Blue test sockets		Continue testing with next test step.	Malfunction: Resistance not within tolerance.
Operation in vehicle: -----			



Top view of control-unit plug

Trouble-shooting:

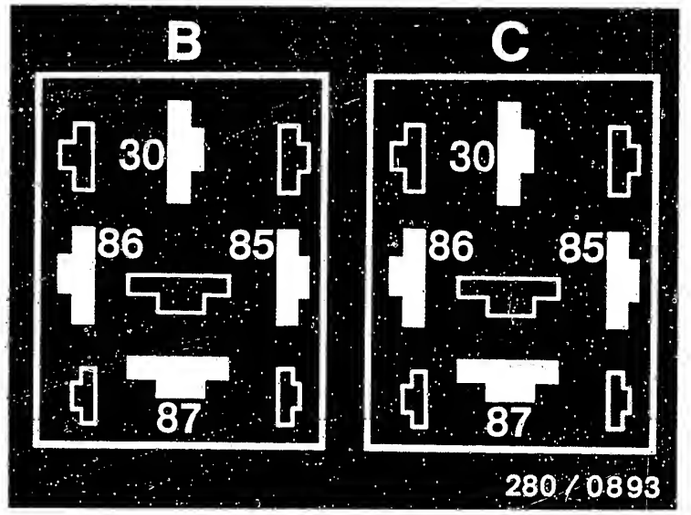
For testing, disconnect control-unit plug from test adapter and use circuit diagram if necessary.

Check the following leads for continuity with ommeter (set value approx. 0Ω):

- From control-unit plug term. 23 to solenoid-operated injection valve No. 4
- From solenoid-operated injection valve No. 4 to pump relay term. 87
- Resistance measurements at solenoid-operated injection valve No. 4
  Ambient temperature (+15°C...+30°C): 15 ... 17.5 Ω
  Engine at op. temp. (+80°C): 17 ... 20.0 Ω
- Check plug-in tabs for security.

Installation position of components:
Solenoid-operated injection valve No. 4: in engine compartment at rear right
Pump relay: in engine compartment on left in a box (right-hand relay)

Main relay (B) and pump relay (C) disconnected.
Top view of plugs



Testing with the universal test adapter is now completed.

Now perform the fuel pressure test.

If a fault is found when testing, the test must be repeated after the fault has been eliminated.

The fuel pressure test is described starting on Coordinate E4.

Fuel pressure test

Electric fuel pump operating?
Listen
- Pump fuse
- Main relay and pump relay
- Voltage at electric fuel pump

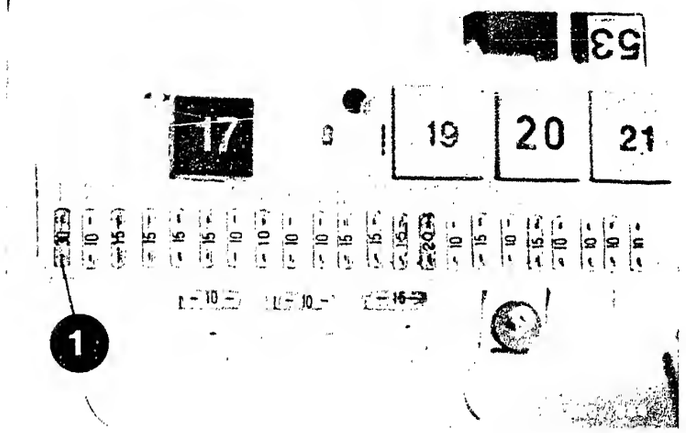
no →

- Check pump fuse
  The pump fuse is in the central fuse box No. 1
  The fuse box is on the left under the steering wheel.
- Pump fuse O.K.?
  No - replace.
  If yes -
- Check main relay and pump relay
  (in engine compartment on left with box above ignition coil)
- Ignition "ON"
  Battery voltage at:
  Connector A - red lead term. 30.
  Main relay B - term. 30, 85, 87
  Pump relay C - term. 30, 85
- Operate starting motor
  Pump relay C - term. 87.
  If no voltage, check connecting leads. If no fault detectable, check relay.
- Check main relay
  Ignition "ON"
  Measure voltage between term. 30 and term. 86 - battery voltage
  between term. 86 and term. 87 - battery voltage
  If not - replace relay.
- Pump relay
  Disconnect main relay and insert pump relay instead.

yes ↓

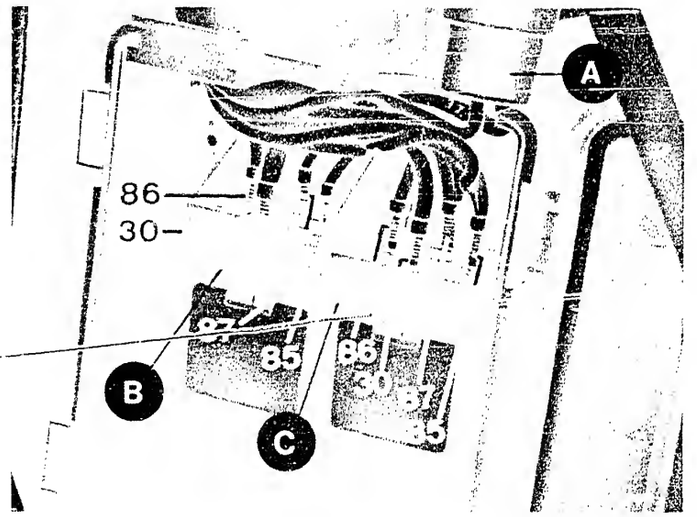
Continued on E8/E9

Continued on E6/E7



1=Pump fuse

A=Connector
B=Main relay
C=Pump relay



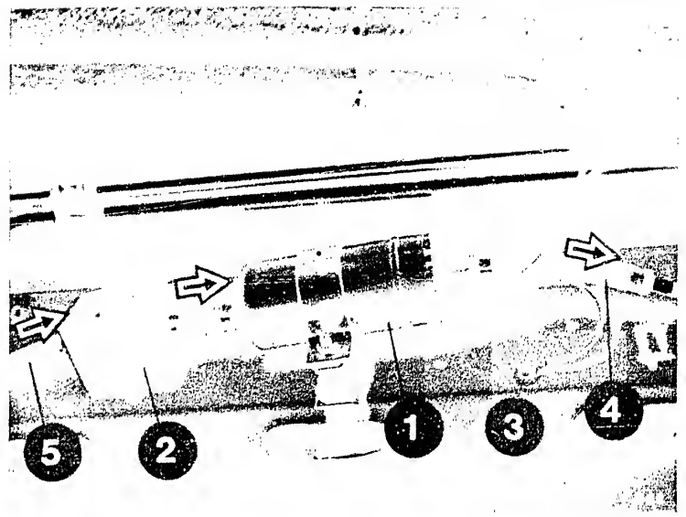
Fuel pressure test (continued)

Ignition "ON".
Battery voltage present at term. 86 and term. 87!
No - replace relay.
Yes - check connections at pump relay base.
Electric fuel pump still not operating?

- Check voltage directly at electric fuel pump.
  Start engine.
  Set value min. 12 V
  Test specification not reached?
- Check ground connection
- Check connecting lead from electric fuel pump to pump relay
- If necessary, replace electric fuel pump.

yes

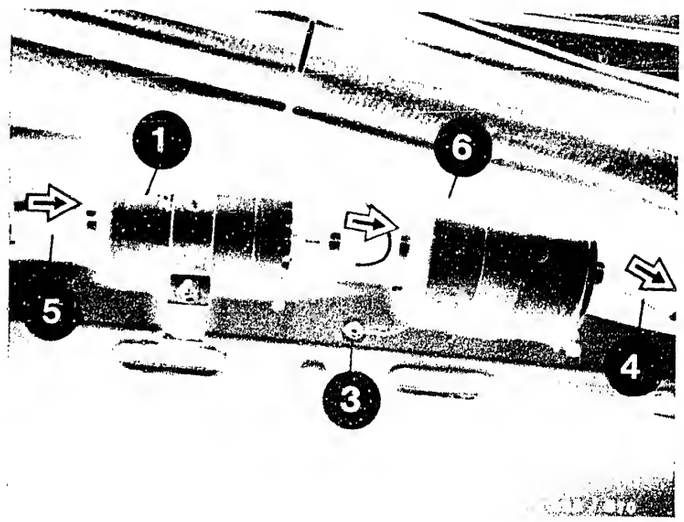
Continued on E8/E9



EU version

1=Electric fuel pump
2=Intake filter
3=Ground connection of electric fuel pump
4=Fuel delivery line
5=Fuel intake line
6=Fuel filter
Arrow=Direction of fuel flow

US version



Fuel pressure test (continued)

Fuel pressure O.K.?
- Test specification: 2.3...2.7 bar

Test specification reached?

no

Testing the fuel pressure

- Connect pressure gauge.

- Connection at fuel inlet distribution pipe (1) (top picture)
- Prepare pressure gauge 1 687 231 154 for measuring.
  Carefully loosen Y-piece. Do not damage hose or Y-piece.

- Carefully loosen hexagon screw on fuel inlet distribution pipe.
  Caution. When loosening the hexagon screw make sure that no fuel gets onto hot parts of the engine.

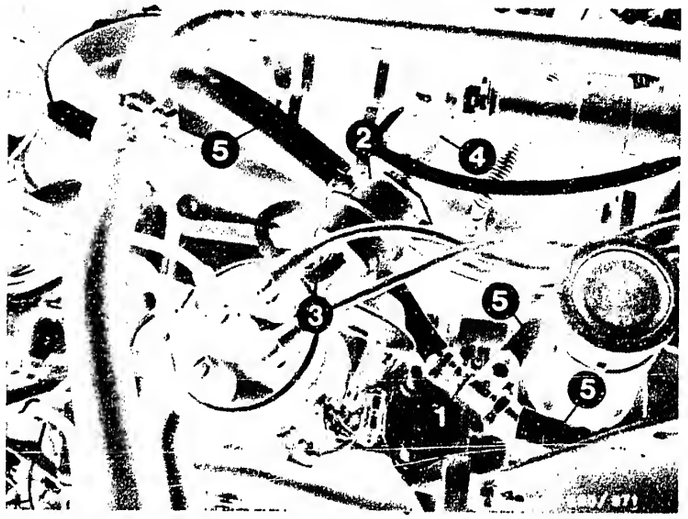
- Connect hose from pressure gauge (1) (bottom picture)

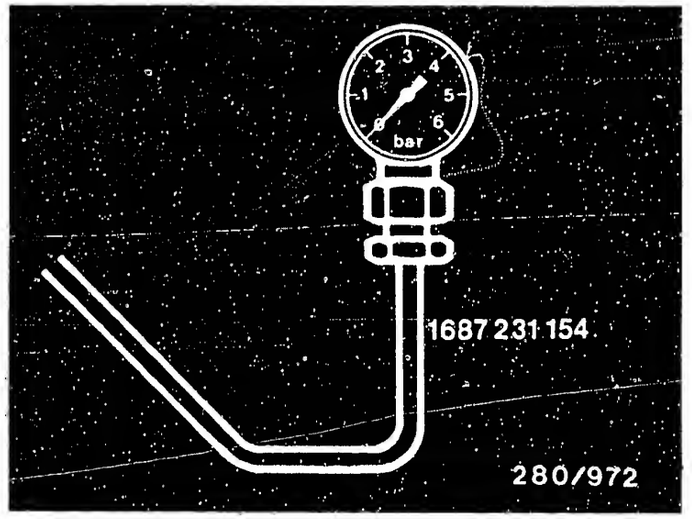
- Make sure there are no leaks (use hose clamp if necessary).

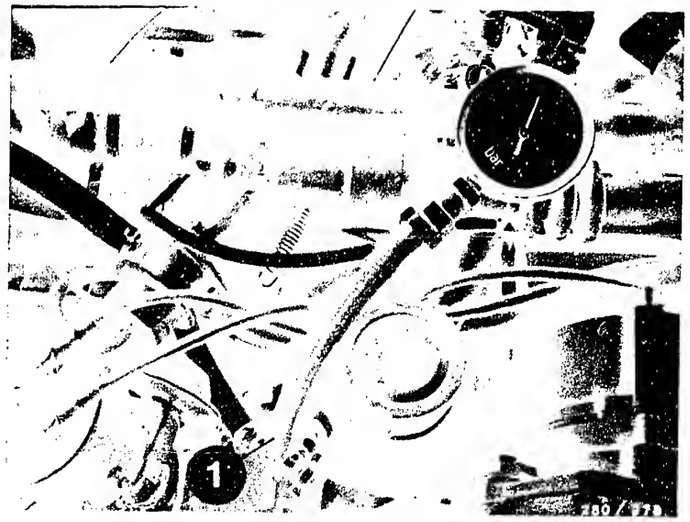
yes

Continued on E12/E13

Continued on E10/E11







Fuel pressure test (continued)

- Jumping the safety circuit

- Open relay box in engine compartment on left.

- Disconnect pump relay.

- Insert jumper between term. 30 and term. 87.

- Electric fuel pump operates; read off fuel pressure on pressure gauge.

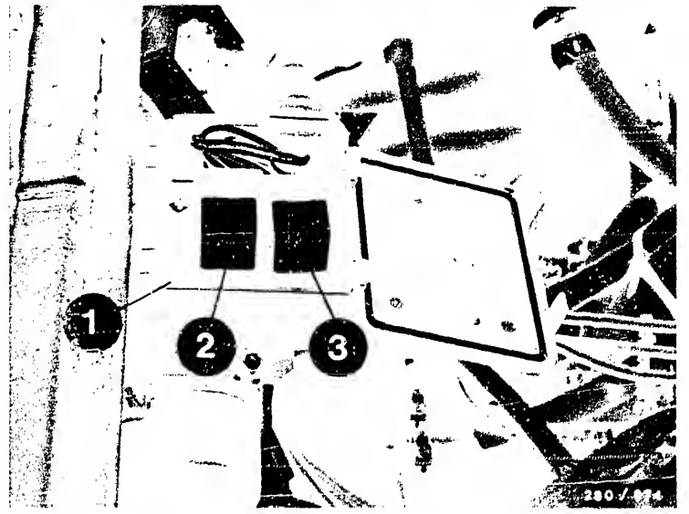
- Fuel pressure
  Test specification: 2.3 ... 2.7 bar

  Remove jumper and re-connect pump relay.
  Start engine and let it run.

yes

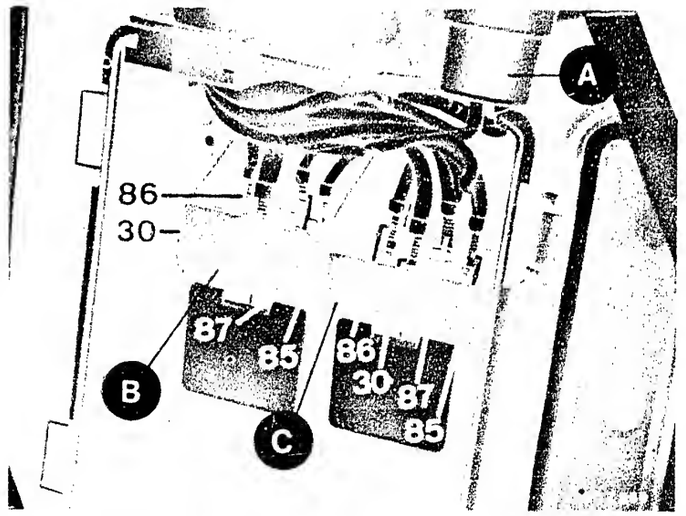
- Fuel pressure
  Test specification approx. 2.0 bar
  (depends on intake-manifold pressure)

  If incorrect?



1=Relay box
2=Main relay
3=Pump relay

C=Pump relay



Continued on E12/E13

Fuel pressure test (continued)

Fuel pressure O.K.?
Pressure regulator O.K.?
Test specification:
2.3...2.7 bar

Test specification reached?

no

- Check pressure regulator
  Start engine and let it run
  Fuel pressure test specification:
  approx. 2.0 bar

  Disconnect vacuum hose from pressure regulator.
  Fuel pressure test specification:
  2.3 ... 2.7 bar

  Fuel pressure of 2.3 bar not reached:

- Slowly pinch off fuel return line.
  Caution: Do not load pressure gauge above 6 bar .
  If pressure rises above 4 bar - replace pressure regulator. The pressure regulator is mounted on the fuel-distribution pipes by fuel lines.

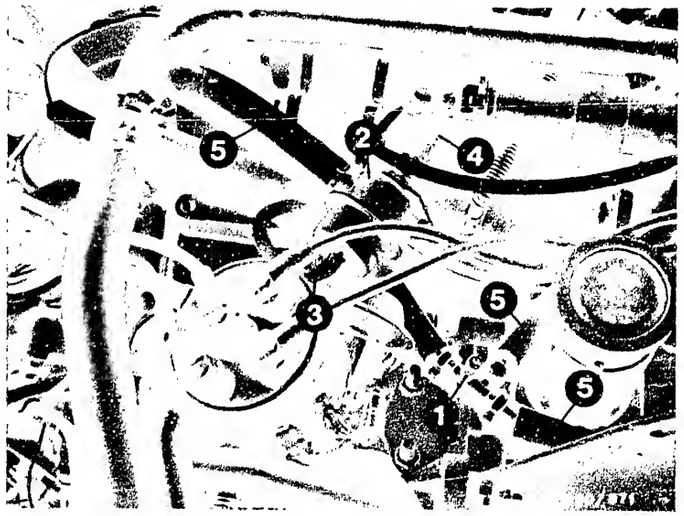
- Fuel delivery line, fuel filter clogged.
- Strainer in tank clogged.
- Corrosion in tank.

  Fuel pressure of 2.7 bar exceeded:

- Fuel return line clogged or pinched.
- Replace pressure regulator.

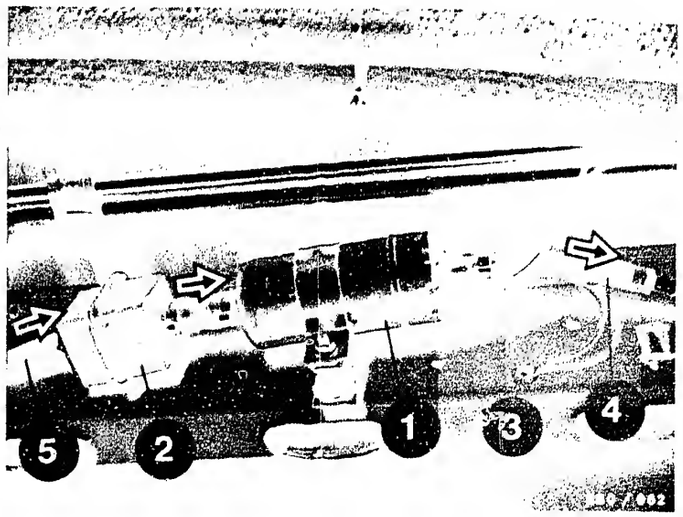
yes

Continued on E14/E15



2=Pressure regulator
3=Hose to intake manifold
4=Fuel return line
5=Fuel delivery lines

1=Electric fuel pump
2=Intake filter (EU version)
3=Ground connection of electric fuel pump
4=Fuel intake line
5=Fuel delivery line



Fuel pressure test (continued)

Does fuel pressure remain almost constant after stopping the engine?

Test specification:
2.3...2.7 bar

Test specification reached?

no

The fuel pressure drops quickly after stopping the engine when hot.

- Check the fuel system for leaks (build up fuel pressure):
  fuel pressure: 2.3 ... 2.7 bar

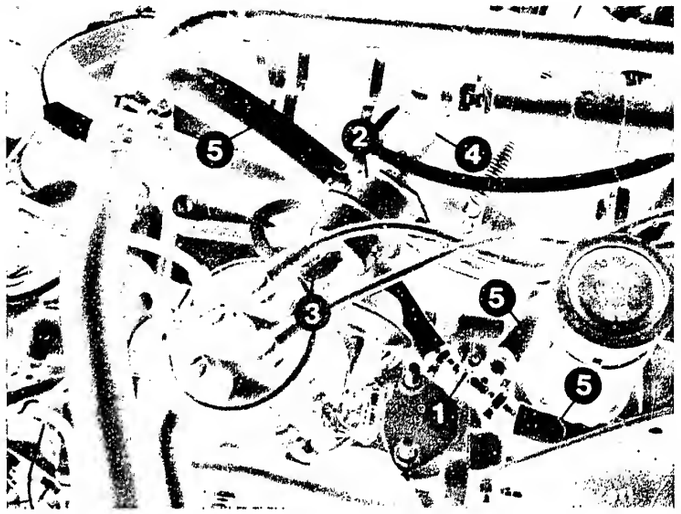
  Remove jumper and observe pressure gauge. After approx. 20 min the fuel pressure must still be at least 1.0 bar.

  If not:

- Check for leaks at joints between components and fuel hoses/lines.
- Pressure regulator (diaphragm)
- Check injection valves (needle seat, valve not closing properly).
- Check electric fuel pump (non-return valve leaking).
- Fuel filter leaking.

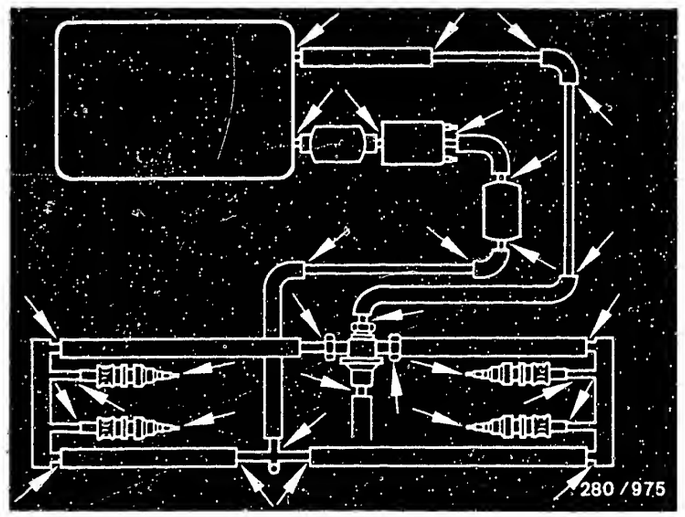
yes

Remove pressure gauge. Connect screw plug on fuel inlet distribution pipe.
Remove jumper and connect pump relay in connection base. The fuel pressure test is now completed. If the fault has not been found or if further instructions are required on how to eliminate the fault, continue with the trouble-shooting chart of your choice.
Detailed trouble-shooting chart (Coordinates C3/C4)
Direct trouble-shooting chart (Coordinates C5...C8).



2=Pressure regulator
3=Connection to intake manifold
4=Fuel return line
5=Fuel delivery line

Diagram of fuel lines
Arrows indicate joints between hoses and components.



STARTING MOTOR OPERATES, ENGINES FAILS TO START OR STARTS ONLY WITH GREAT DIFFICULTY

Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHOOTING

Ignition, engine etc. O.K.? — no → Eliminate faults in ignition and engine.

yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

yes

Continued on E18/E19

Starting motor operates, engines fails to start or starts only with great difficulty

(continued)

yes

Cold-start control O.K.?
(control unit function)

- Take out pump fuse (No. 1)
- Connect test lead between an injection valve.
- Disconnect plug from engine temperature sensor II (double NTC). Color of plug blue
- Connect motortester/multimeter to test lead. (V setting, measuring range 10 V).
- Disconnect ignition cable term. 4 from ignition distributor and connect to ground by way of a spark gap. Start engine. Voltage at injection valve must drop during starting from approx. 5 V to approx. 0.5 V (with engine at normal operating temperature or with NTC II plug connected the voltage is less than 0.5 V). Re-establish original condition after testing.

no

Functional test:

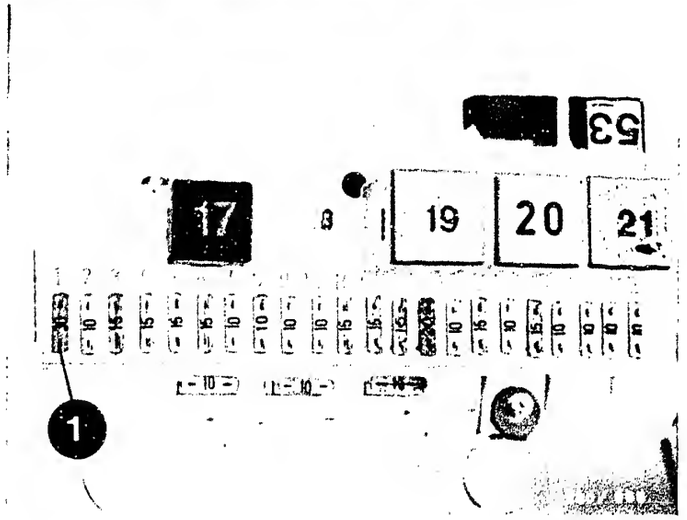
- Remove pump fuse.
- Disconnect ignition cable term. 4 from ignition distributor cap and connect to vehicle ground with spark gap. (Caution! Engine must not start).

Caution:
When using a spark gap - in order to prevent irreparable damage to the trigger box - an interference-suppression resistor of at least 2 kΩ must be connected between spark gap and ignition coil term. 4, e.g. sleeve-type suppressor (5 kΩ) 0 356 500 001.

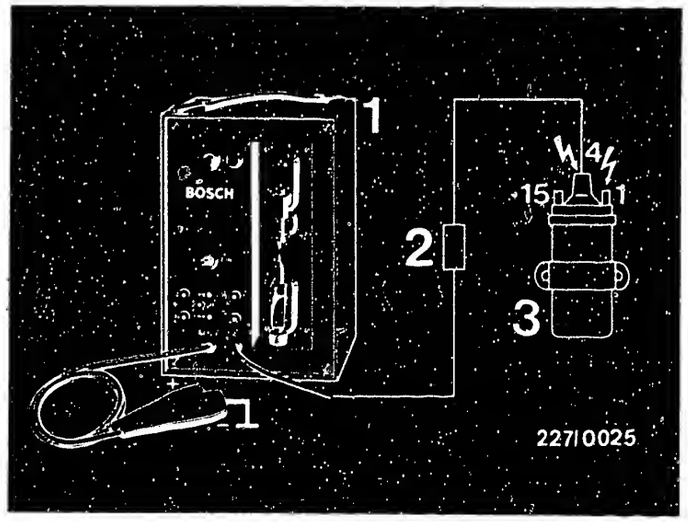
yes

Continued on E22/E23

Continued on E20/E21



1=Pump fuse



1=Spark gap
2=5 kΩ sleeve-type suppressor
3=Ignition coil

=dangerous voltages
(400 V - 25 kV)

Starting motor operates, engine fails to start or starts only with great difficulty

(continued)

yes

- Connect test lead 1 684 463 093.

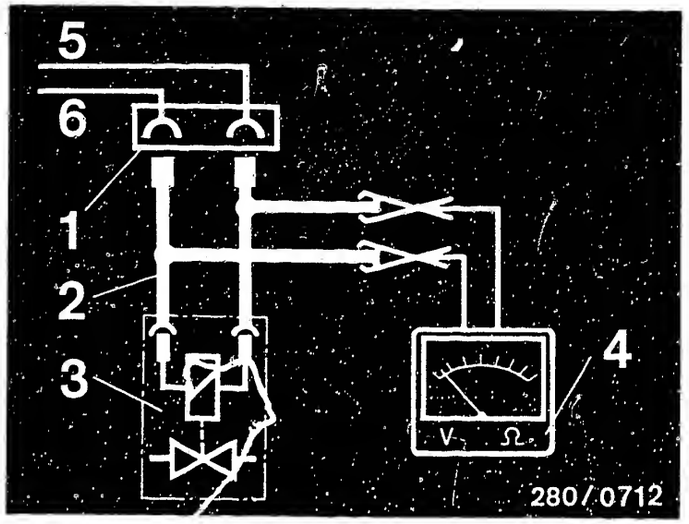
  Connect 2-pole test lead 1 684 463 093 between an injection valve and its electrical connecting lead.

- Disconnect plug from temperature sensor II (engine).
  (Double NTC, color of plug blue)
  Engine must not start when starting motor is operated.

- Measuring:
- Start engine
- Voltage reading drops from initially approx. 5 V within approx. 15 sec cranking time to approx. 0.5 V.
  If voltage values not reached, replace control unit.
- Wait approx. 1 minute before repeating voltage test.
- Connect plug on temperature sensor. If engine at normal operating temperature, start.
  Voltage reading less than 0.5 V.
  If not, replace temperature sensor II (double NTC).

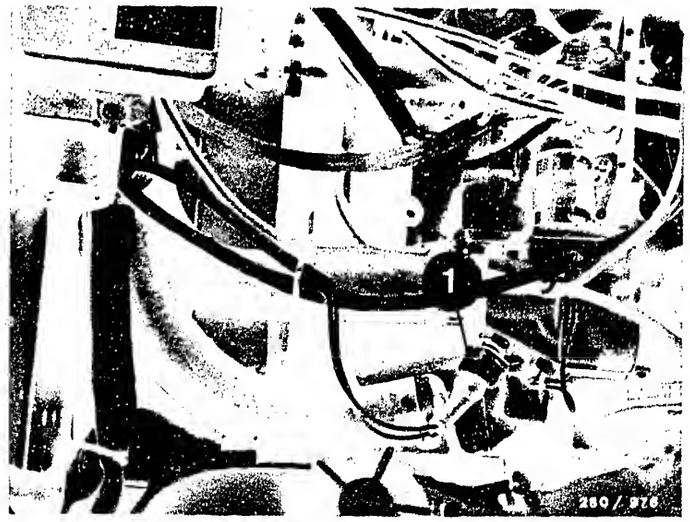
  Caution
  Re-establish the original condition after testing.

Continued on E22/E23



1=Connector of injection valve lead
2=Test lead 1 684 463 093
3=Injection valve
4=Multimeter/motortester
5=from pump relay term. 87
6=from control relay term. 11
or 12 or 23 or 24

1=Temperature sensor II (engine)
(blue plug)



Starting motor operates, engine fails to start or starts only with great difficulty

(continued)

yes

On US version only
Auxiliary-air device mechanically O.K.?
Free cross-section?
- cold - open?
- warm - closed?
- Engine-speed drop when hose pinched off? (engine cold).

no →

Testing:
- Visual examination of auxiliary-air device. Disconnect hoses and look down (possibly using a small mirror). When cold, the cross-section must be partially open; when the engine is warm it must be closed. If not, replace auxiliary-air device.
- Functional test of auxiliary-air device: With engine cold, pinch off hose to auxiliary-air device. Engine speed must drop. With the engine warm, pinch off hose to auxiliary-air device. Engine speed must not drop noticeably. If not, replace auxiliary-air device (pay attention to the direction of flow).

yes

On US version only
Electrical operation of auxiliary-air device (power supply, ground lead, resistance) O.K.?

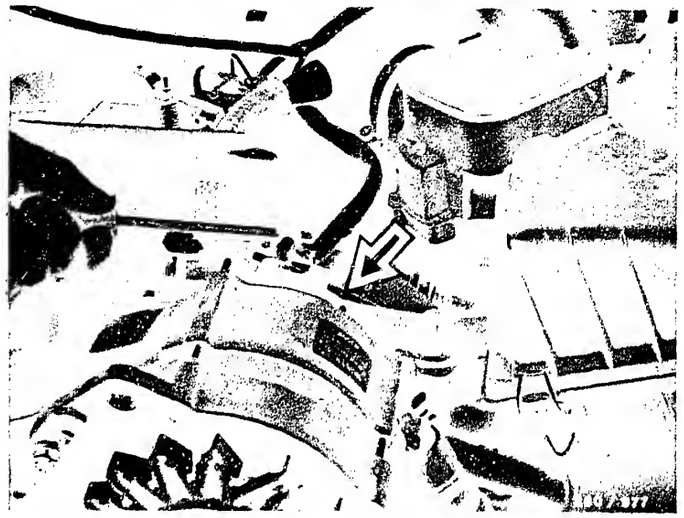
no →

Start engine.
- Voltage at plug min. 12 V. If not, check the following leads for continuity (set value approx. 0Ω):
- From term. 33 to central ground.
- From term. 34 to pump relay term. 87.
- Resistance of auxiliary-air device 20 ... 55Ω (plug disconnected).

If the resistance is not within tolerance, replace the auxiliary-air device.

yes

Continued on F1/F2



Arrow=Auxiliary-air device

Starting motor operates, engine fails to start or starts only with great difficulty

Air-flow sensor mechanically O.K.?

no

(continued)

Testing:
Loosen clamp-type fasteners on air filter. Lift off top part of air filter.

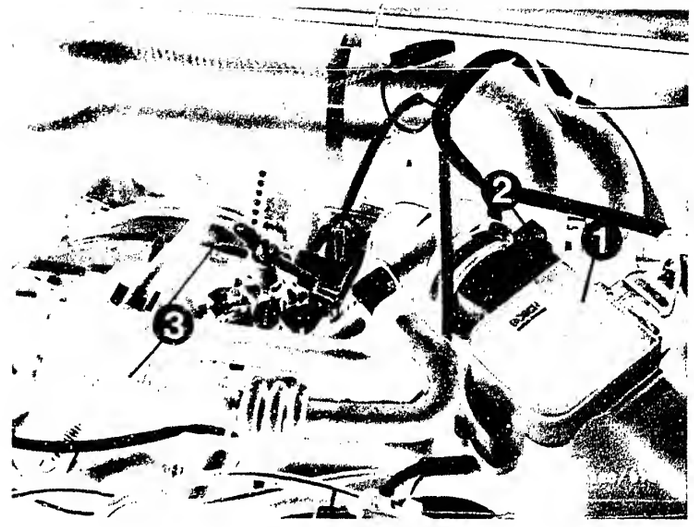
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.

- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
Caution: after testing is completed, the air filter and the air-flow sensor must be re-assembled.

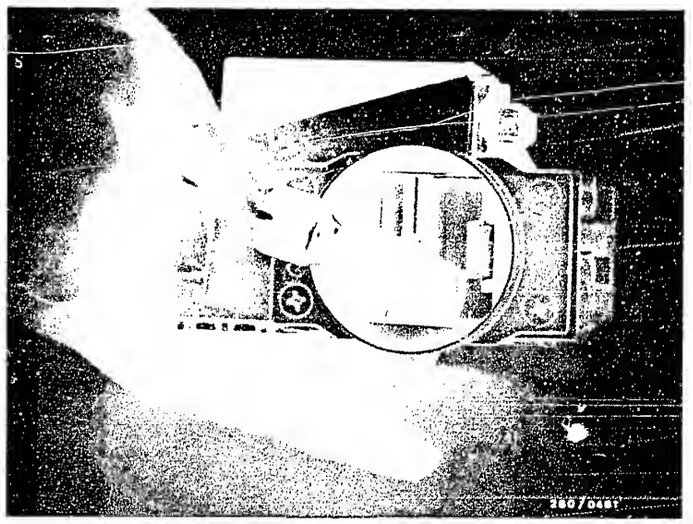
yes

Continued on F3/F4



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Starting motor operates, engine fails to start or starts only with great difficulty

(continued)

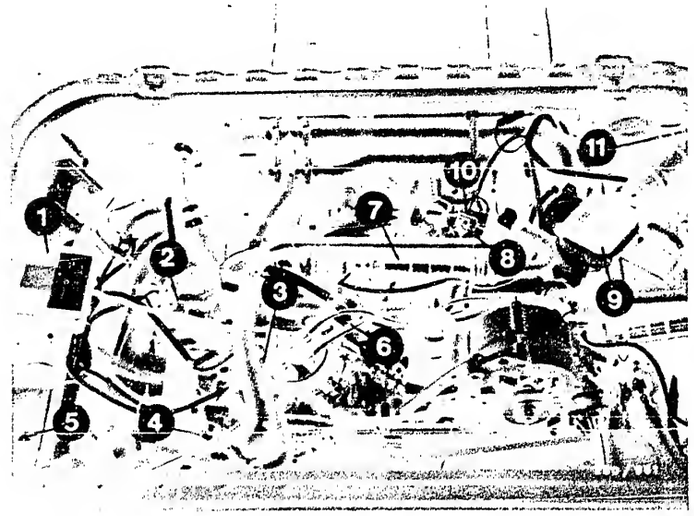
yes

Are all hose lines and electrical lead connections correctly connected, not kinked or damaged?
Visual examination.
Air-intake system checked for leaks with 0.3 bar gauge pressure?

no →

- Check whether hoses of air-intake system and of fuel line system are correctly connected, not kinked or damaged. If necessary, replace hoses. Eliminate leaks by new seals or by re-tightening the connecting screws.
- Leak test:
  Seal off the exhaust tail pipe. Loosen clamp-type fasteners on air filter. Lift off top part of air filter and seal off air-flow sensor duct. Disconnect hose after idle actuator (EU version) or auxiliary-air device (US version) and blow air (0.3 bar gauge pressure) into the intake manifold with a compressed-air gun. Seal off connection port on idle actuator/auxiliary-air device. Fully open throttle valve. Brush or spray all joints with soapy water. Leaks may also occur at the following points on the engine: oil dipstick not securely inserted, defective cap seal on oil filler neck etc.
  Bubbling or foaming indicates a leak.

yes



EU version (US version similar)
1 =Main and pump relays
2 =Injection valves
3 =Central ground
4 =Temperature sensor II
5 =Control unit
6 =Pressure regulator
7 =Idle actuator
8 =Full-load switch
9 =Air-flow sensor
10 =Idle switch
11 =Idle controller(behind a cover)

Continued on F5/F6

Starting motor operates, engine fails to start or starts only with great difficulty

(continued)

yes

Trouble-shooting program completed for customer complaint

"Starting motor operates, engine fails to start or starts only with great difficulty".

Fault eliminated?

no

Further possibilites:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).
- Engine not mechanically O.K. (compression, valve setting, valve timing, worn camshaft).

ENGINE STARTS BUT THEN DIES

Trouble-shoqting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

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If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHCOTING

Ignition, engine etc.O.K.? — no → Eliminate faults in ignition and engine.

yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

yes

Continued on F9/F10

Engine starts but then dies (continued)

yes

On US version only
Auxiliary-air device mechanically O.K.?
- cold - open?
- warm - closed?
- Engine-speed drop when hose pinched off? (engine cold).

no →

Testing:
- Visual examination of auxiliary-air device
  Disconnect hoses and look down (possibly using a small mirror). When cold, the cross-section must be partially open; when the engine is warm it must be closed. If not, replace auxliary-air device.

- Functional test of auxiliary-air device:
  With engine cold, pinch off hose to auxiliary-air device. Engine speed must drop. With the engine warm, pinch off hose to auxiliary-air device. Engine speed must not drop noticeably. If not, replace auxiliary-air device (pay attention to the direction of flow).

yes

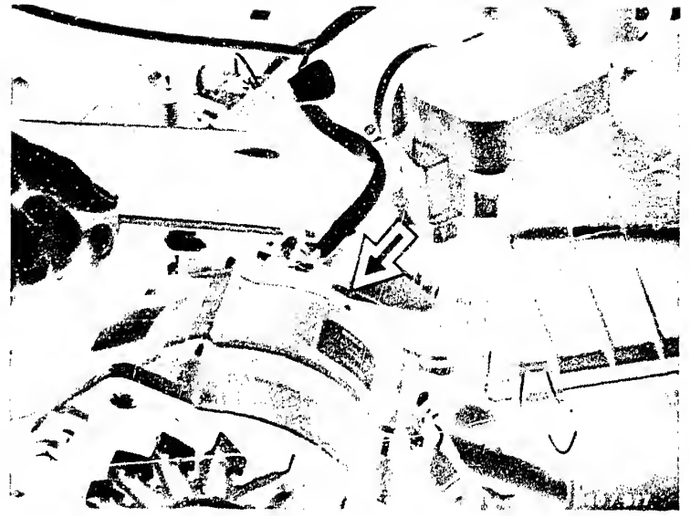
On US version only
Electrical operation of auxiliary-air device (power supply, ground lead, resistance) O.K.?

no →

Start engine.
- Voltage at plug min. 12 V. If not, check the following leads for continuity (set value approx. 0Ω):
- From term. 33 to central ground.
- From term. 34 to pump relay term. 87.
- Resistance of auxiliary-air device 20 ... 55Ω (plug disconnected).
  If the resistance is not within tolerance, replace the auxiliary-air device.

yes

Continued on F11/F12



Arrow=Auxiliary-air device

Engine starts but then dies (continued)

Solenoid-operated injection valves leak-tight?

no

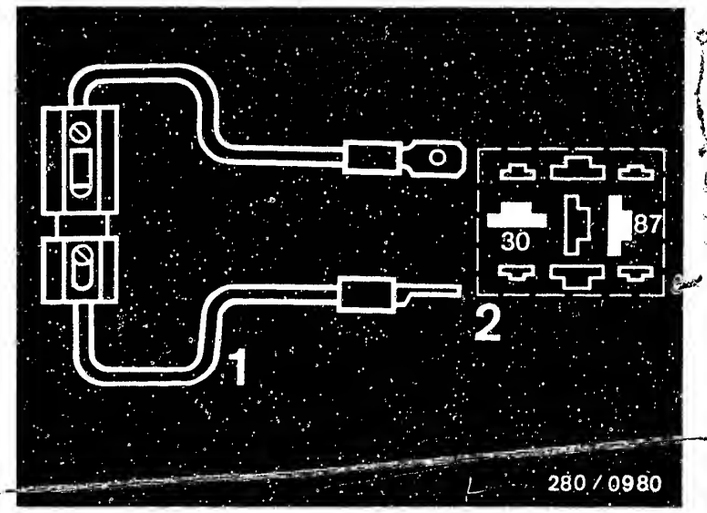
yes

- Leak test on solenoid-operated injection valves
- Remove fuel-distribution pipes (left and right) with injection valves:
  Remove injection valves in pairs. Pull the two injection valves simultaneously and carefully out of the cylinder head. Fuel lines remain connected.
  Build up the fuel pressure:
  Jump the safety circuit.
  Caution:
  Make sure that no fuel gets onto hot parts of the engine.
  Test specification:
  Within 60 sec no drop may fall from the mouth of the injection valve. If defective, replace injection valve.
- Removal
- Pull off electrical connection.
- Break open hose-termination sleeve on fuel-distribution pipe.
- Cut open hose in longitudinal direction with a soldering iron and pull off injection valve.
  Caution: Catch any escaping fuel. Do not allow to drip onto hot parts of the engine.
  Warning: Before installing, grease the rubber seals at the valve mouth sleeve only lightly (silicone grease Ft 2 v 1). The other injection-valve parts must remain grease-free.
- Installation
- Plug on hose-termination sleeve (fuel-distribution pipe).
- Plug on injection valve (check for leaks at joints).
  Caution: After testing the injection valves and the fuel-distribution pipes, re-establish the original condition. Check for leaks (unmetered air).

Continued on F13/F14

1=Fuel-distribution pipe
2=Injection valves

1=Jumper with fuse holder and 10A fuse (user-fabricated)
2=Top view of pump relay connection base



Engine starts but then dies (continued)

yes

Air-flow sensor mechanically O.K.? — no

Testing:
Loosen clamp-type fasteners on air filter.
Lift off top part of air filter.

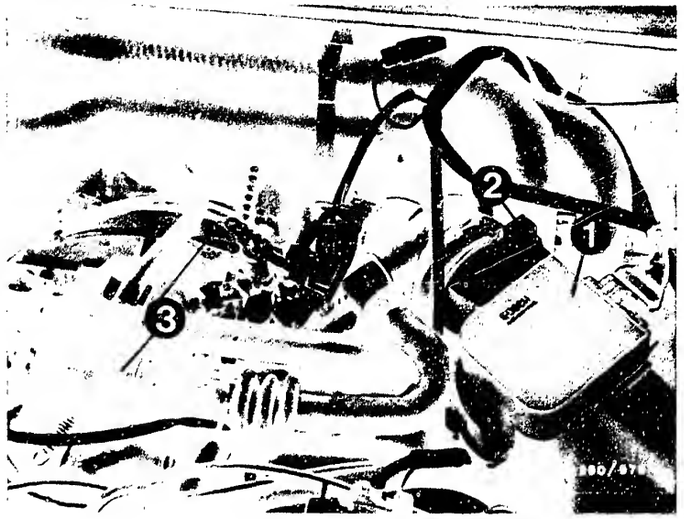
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.

- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
Caution: after testing is completed, the air filter and the air-flow sensor must be re-assembled.

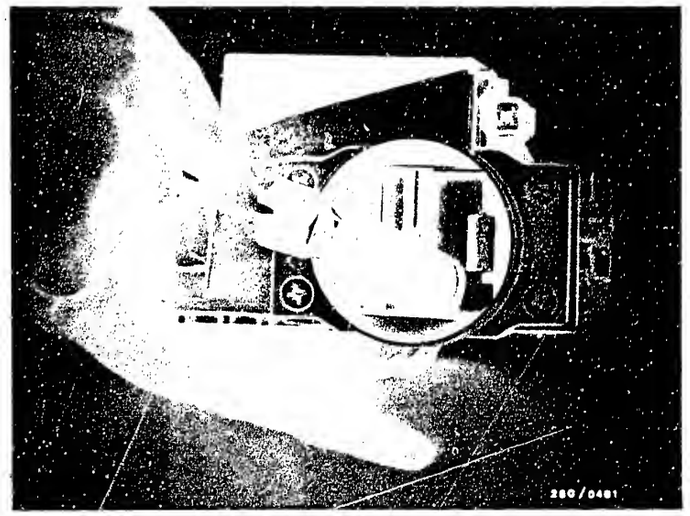
yes

Continued on F15/F16



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Engine starts but then dies (continued)

yes

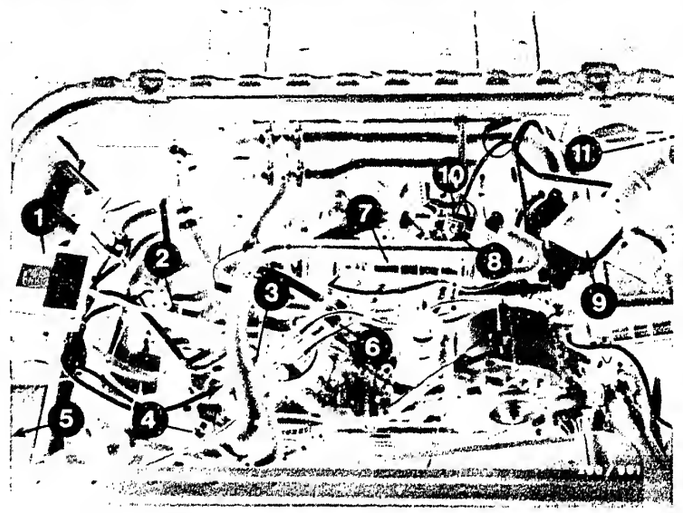
Are all hose lines and electrical lead connections correctly connected, not kinked or damaged?
Visual examination.
Air-intake system checked for leaks with 0.3 bar gauge pressure?

no →

- Check whether hoses of air-intake system and of fuel line system are correctly connected, not kinked or damaged. If necessary, replace hoses. Eliminate leaks by new seals or by re-tightening the connecting screws.
- Leak test:
  Seal off the exhaust tail pipe. Loosen clamp-type fasteners on air filter. Lift off top part of air filter and seal off air-flow sensor duct. Disconnect hose after idle actuator (EU version) or auxiliary-air device (US version) and blow air (0.3 bar gauge pressure) into the intake manifold with a compressed-air gun. Seal off connection port on idle actuator/auxiliary-air device. Fully open throttle valve. Brush or spray all joints with soapy water. Leaks may also occur at the following points on the engine: oil dipstick not securely inserted, defective cap seal on oil filler neck etc.
  Bubbling or foaming indicates a leak.

yes

Continued on F17/F18



EU version (US version similar)
1 = Main and pump relays
2 = Injection valves
3 = Central ground
4 = Temperature sensor II
5 = Control unit
6 = Pressure regulator
7 = Idle actuator
8 = Full-load switch
9 = Air-flow sensor
10= Idle switch
11= Idle controller
(behind a cover)

Engine starts but then dies (continued)

yes

Trouble-shooting program completed for customer complaint

"Engine starts but then dies".

Fault eliminated?

no

Further possibilities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).

- Engine not mechanically O.K. (compression, valve setting, valve timing, worn camshaft).

ROUGH IDLE; INCORRECT IDLE SPEED

Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHOOTING

Ignition, engine etc.O.K.? — no → Eliminate faults in ignition and engine.

yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

yes

Continued on F21/F22

Rough idle, incorrect idle speed (continued)

yes

Throttle valve closed?
- Throttle lever coming up against stop screw?
- Throttle cable free of tension?
- Throttle cable without kinks?

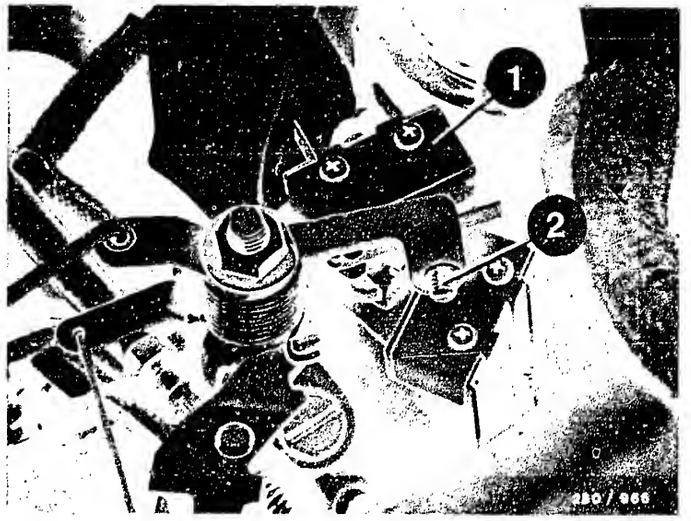
no

- Testing
  Check whether the throttle valve can be closed still further and whether the engine speed thereby drops.
- Adjusting the throttle valve:
  The throttle valve must come up against the stop screw with the throttle lever just before it sticks. Lock stop screw by means of lock nut.
- If throttle cable kinked - replace.

yes

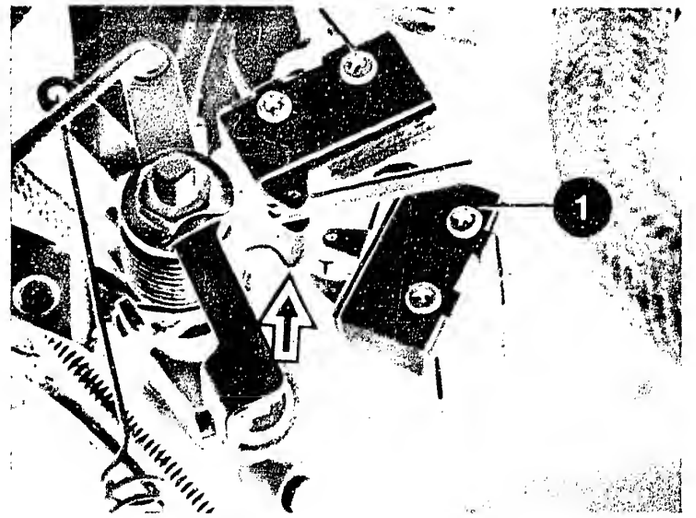
Continued on G1/G2

Continued on F23/F24



1=Idle switch
2=Adjusting screw

3=Full-load switch
Arrow=Cam plate



Rough idle, incorrect idle speed (continued)

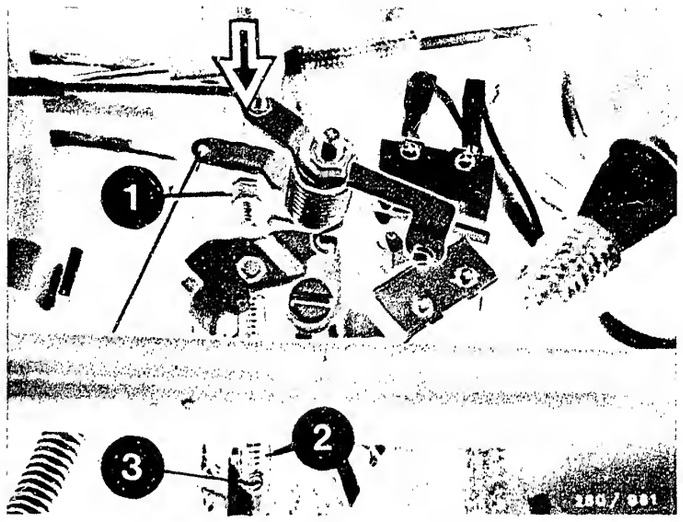
yes

- ADJUSTING THE THROTTLE ACTUATION

The throttle actuation must be adjusted so that, with the throttle valve closed (idle), the actuating lever on the transmission is at the stop in the zero-throttle position. Otherwise the upshifts at medium speeds take place too late.

Adjust the throttle actuation in the idle position (engine at normal operating temperature, throttle valve closed) as follows:

- loosen nut - 1.
- Remove overtravel spring - 2.
- Pull rod for throttle actuation in direction of arrow (zero-throttle position).
- Adjust end-piece - 3 - by turning with a screwdriver so that the stop face of the end-piece is up against the pin of the actuation shaft.
- Install overtravel spring - 2.
  Start the engine and check whether idle speed is obtained. If necessary, re-adjust by turning end-piece - 3.
- Lock end-piece with nut - 1.



Continued on G1/G2

Rough idle, incorrect idle speed (continued)

yes

On US version only
Auxiliary-air device mechanically O.K.?
- cold - open?
- warm - closed?
- Engine-speed drop when hose pinched off? (engine cold).

no

Testing:
- Visual examination of auxiliary-air device. Disconnect hoses and look down (possibly using a small mirror). When cold, the cross-section must be partially open; when the engine is warm it must be closed. If not, replace auxiliary-air device.

- Functional test of auxiliary-air device: With engine cold, pinch off hose to auxiliary-air device. Engine speed must drop. With the engine warm, pinch off hose to auxiliary-air device. Engine speed must not drop noticeably. If not, replace auxiliary-air device (pay attention to the direction of flow).

Arrow=Auxiliary-air device

yes

On US version only
Electrical operation of auxiliary-air device (power supply, ground lead, resistance) O.K.?

no

Start engine.
- Voltage at plug min. 12 V. If not, check the following leads for continuity (set value approx. 0Ω):
- From term. 33 to central ground.
- From term. 34 to pump relay term. 87
- Resistance of auxiliary-air device 20 ... 55 Ω (plug disconnected).

If the resistance is not within tolerance, replace the auxiliary-air device.

yes

Continued on G3/G4

Rough idle, incorrect idle speed (continued)

yes

Solenoid-operated injection valves checked for proper operation?
- Pattern shown opposite visible on oscilloscope?
- No differences or missing or interference detectable?

no

Testing the injection valves for proper operation:
- Connect test lead as follows:
  The two-pole plug connections of the test lead are connected between an injection valve and its connecting lead. Of the other two connection terminals of the test lead, only one need be connected to the special input of the motortester.
- Caution:
  The unused terminal must not come into contact with the bodywork ground.
- If correctly connected, the pattern shown opposite is visible on the oscilloscope. Using the test lead it is possible to test the injection pulses at the injection valves with an ignition oscilloscope with the engine running. If the pattern shown opposite is not obtained or if there are differences (interference, missing etc.), the other injection valves should also be checked.
- In case of interference: check routing of leads.
- In case of missing: eliminate loose contacts in leads or in plug-in connections.

yes

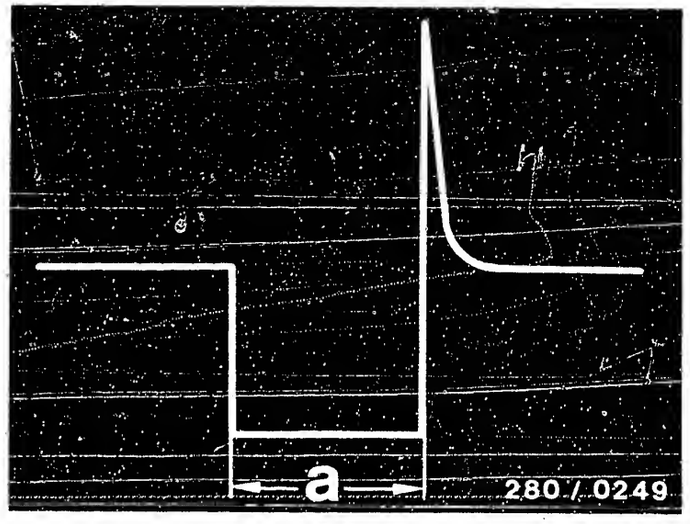
Injection valve mechanically O.K.?
- Does engine speed drop when injection-valve connectors are pulled off?
- Does an injection valve need replacing?

no

- With the engine running, disconnect injection-valve connectors individually, one after the other, from the injection valves and plug on again. Engine speed must drop if injection valve O.K.

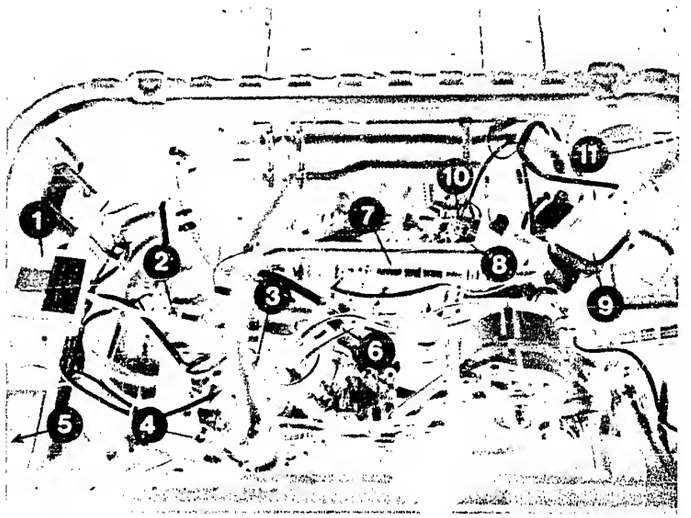
yes

Continued on G5/G6



Injection pulses of a switched output stage (measured at the injection valve)
a=Pulse length (dependent on engine load)

4=Solenoid-operated injection valves



Rough idle, incorrect idle speed (continued)

yes

Solenoid-operated injection valves O.K.?
- Removal and installation

no

- Removal

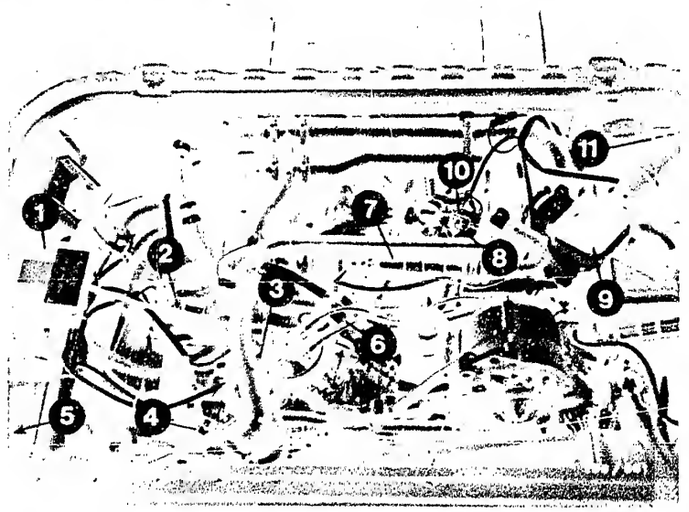
Remove fuel-distribution pipe with injection valves.
- Loosen fastening screws on fuel-distribution pipe and on injection valves.
- Pull injection valves in pairs and carefully out of the cylinder head.
  If injection valves defective on one side, loosen fuel-distribution pipe.
  Caution: make sure that no fuel gets onto hot parts of the engine.
- Pull off electrical connection.
- Break open hose-termination sleeve on fuel-distribution pipe.
- Cut open hose in longitudinal direction with a soldering iron and pull off injection valve.
  Caution: Catch any escaping fuel. Do not allow to drip onto hot parts of the engine.
  Warning: Before installing, grease the rubber seals at the valve mouth sleeve only lightly (silicone grease Ft 2 v 1). The other injection-valve parts must remain grease-free.

- Installation
- Plug on hose-termination sleeve (fuel-distribution pipe).
- Plug on new injection valve (watch for leaks).

Install the other components so as to re-establish the original condition.

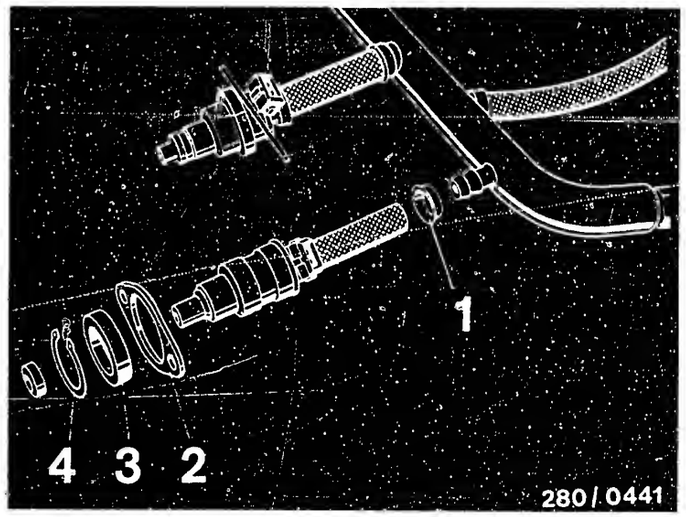
yes

Continued on G7/G8



4=Injection valves

similar to VW Type 25
1=Hose-termination sleeve
2=Holder
3=Rubber seal
4=Retainer



Rough idle, incorrect idle speed (continued)

yes

Air-flow sensor mechanically O.K.? — no

Testing:
Loosen clamp-type fasteners on air filter.
Lift off top part on air filter.

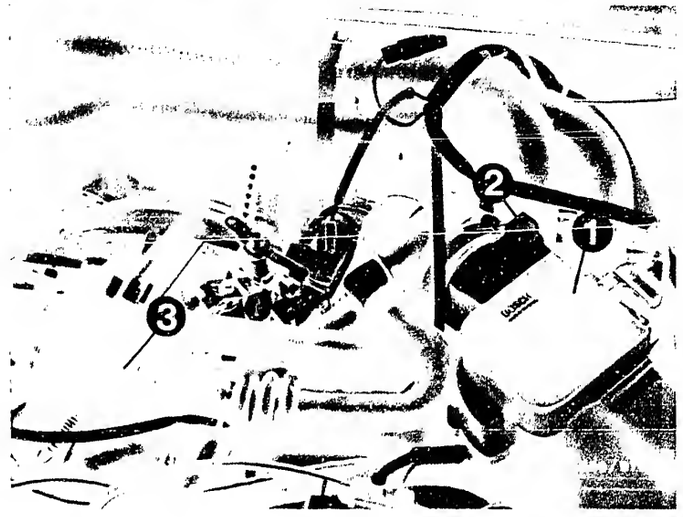
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.

- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

  The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
  Caution: After testing is completed, the air filter and the air-flow sensor must be re-assembled.

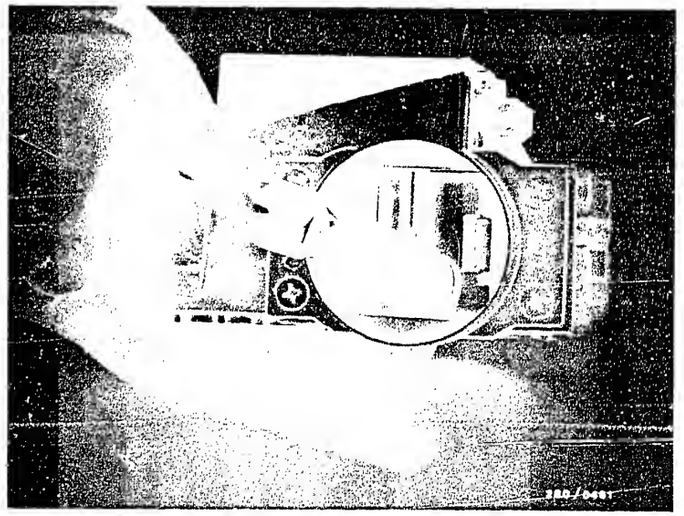
yes

Continued on G9/G10



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Rough idle, incorrect idle speed (continued)

yes

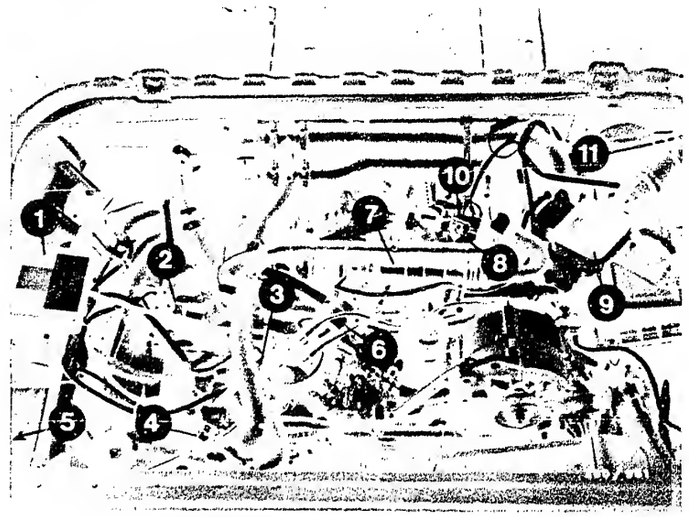
Are all hose lines and electrical lead connections correctly connected, not kinked or damaged?
Visual examination.
Air-intake system checked for leaks with 0.3 bar gauge pressure?

no →

- Check whether hoses of air-intake system and of fuel line system are correctly connected, not kinked or damaged. If necessary, replace hoses. Eliminate leaks by new seals or by re-tightening the connecting screws.
- Leak test:
  Seal off the exhaust tail pipe. Loosen clamp-type fasteners on air filter. Lift off top part of air filter and seal off air-flow sensor duct. Disconnect hose after idle actuator (EU version) or auxiliary-air device (US version) and blow air (0.3 bar gauge pressure) into the intake manifold with a compressed-air gun. Seal off connection port on idle actuator/auxiliary-air device. Fully open throttle valve. Brush or spray all joints with soapy water. Leaks may also occur at the following points on the engine: oil dipstick not securely inserted, defective cap seal on oil filler neck etc.
  Bubbling or foaming indicates a leak.

yes

Continued on G11/G12



EU version (US version similar)
1 =Main and pump relays
2 =Injection valves
3 =Central ground
4 =Temperature sensor II
5 =Control unit
6 =Pressure regulator
7 =Idle actuator
8 =Full-load switch
9 =Air-flow sensor
10=Idle switch
11=Idle controller
(behind a cover)

Rough idle, incorrect idle speed (continued)

yes

EU version:
Idle speed:
320...920 min^{-1}

CO concentration
(with engine at normal operating temperature):
0.8...1.8 vol.%CO

US version:
Idle speed

800...900 min^{-1}

CO concentration
(with engine at normal operating temperature, lambda sensor connected and DIS connected):

0.3...1.1 vol.%CO

Idle speed and CO concentration correctly adjusted?

yes

Continued on G23/G24

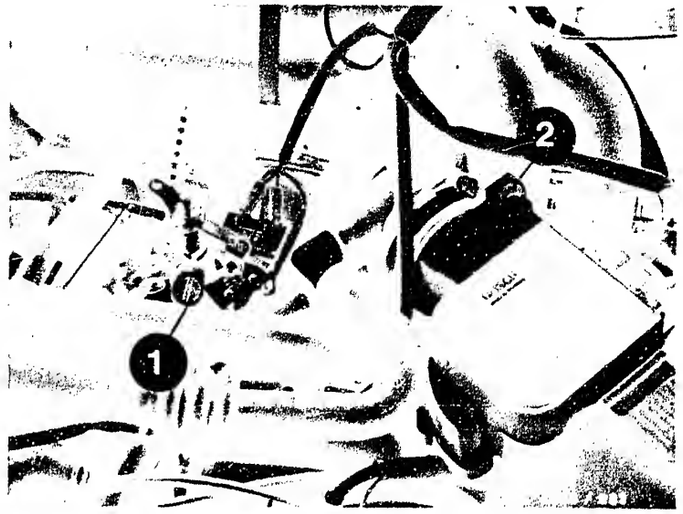
no

Idle speed and CO adjustment
EU version

- Conditions for testing and adjusting
- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not be operating when testing/ adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Ignition timing O.K.
- Switch for overrun cutoff/idle closed.
- As of 7.84 model only: disconnect vacuum hose from retard unit of ignition distributor and seal off.
- As of 7.84 model only: disconnect plugs from DIS control unit and plug together.
- Idle-speed stabilization O.K. (with ignition on valve must vibrate and hum).

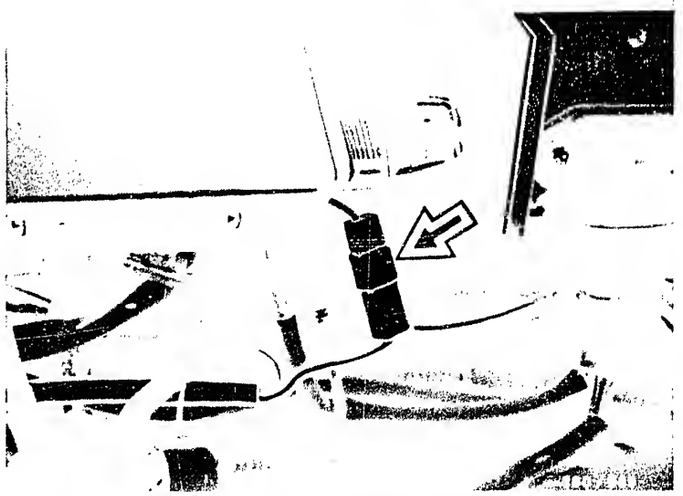
- Test and adjust the idle speed and CO concentration.
- Take apart terminal 1 plug connector (arrow, bottom picture).

Continued on G13/G14



1=Idle-adjusting screw
2=CO adjusting screw

Arrow=Term. 1 plug connector



Rough idle, incorrect idle speed (continued)

- Test the idle speed and CO concentration and, if necessary, adjust to the set value (average value) by alternately turning the adjusting screws.

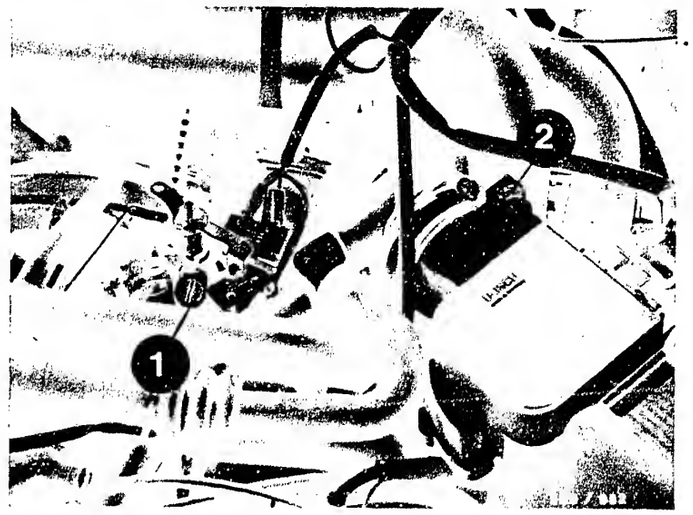
  Set values:
  Idle speed 880 min^{-1}
  CO concentration 1.3 vol.%CO

- Plug together the plugs of terminal 1 plug connector.

- After correcting, lock CO adjusting screw with red anti-tamper cap.

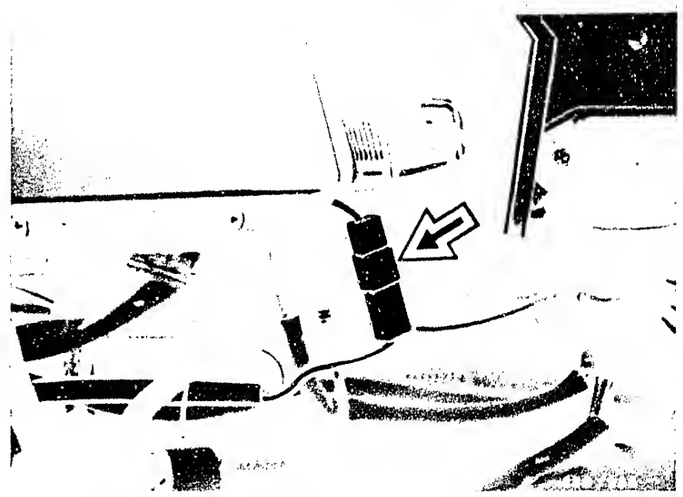
  Note:
  After the CO adjustment, the hose for the crankcase ventilation must be re-connected. If the CO concentration now rises, this is not due to an incorrect adjustment, but to enriching from the crankcase as a result of oil dilution if the engine is operated predominantly over short distances.

  With lenghty, brisk long-distance trips the fuel content in the oil is reduced and the CO concentration comes back to normal.



1=Idle-adjusting screw
2=CO adjusting screw

yes



Arrow=Term. 1 plug connector

Continued on G23/G24

Continued on G15/G16

Rough idle, incorrect idle speed (continued)

yes

- as of 7.84 model only:

- Ignition timing correctly adjusted. Adjust if necessary.

- With idle stabilization connected and retard hose connected, idle speed and CO concentration must comply with the set values.

If not:
- incorrect DIS control unit
- vacuum unit - retard - or hose connection to vacuum unit defective.

US version

- Conditions for testing and adjusting

- Engine at normal operating temperature

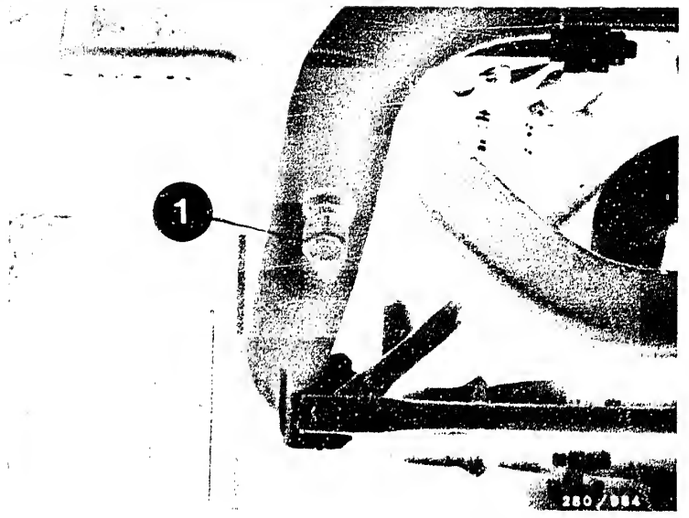
- Electrical devices switched off (radiator fan must not operate when testing/adjusting).

- Hose for crankcase ventilation disconnected from oil breather and plugged tight.

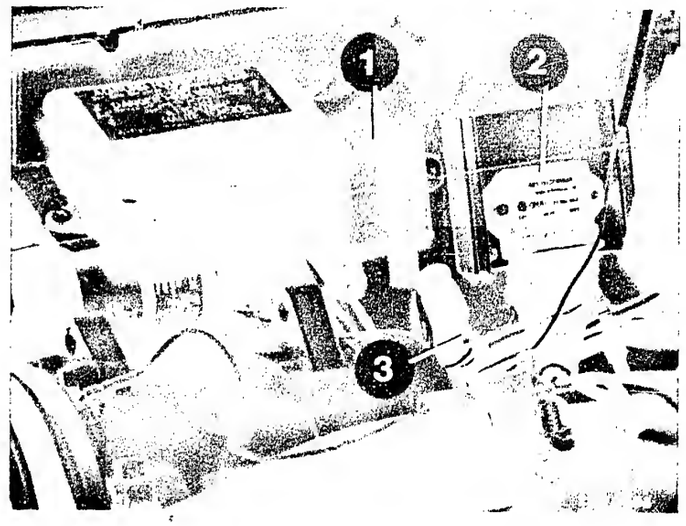
- Switch for overrun cutoff/idle closed.

Continued on G23/G24

Continued on G17/G18



1=Exhaust sampling point



1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected.

Rough idle, incorrect idle speed (continued)

yes

- Testing and adjusting the idle speed and CO concentration

- Connect testers for ignition timing and engine speed.

- Connect hose of CO tester to the sampling point on the left-hand exhaust pipe by means of screw-type sleeve V.A.G 1506.

- Keep to the sequence of testing/adjusting operations.

- Check the ignition timing and adjust if necessary.

- Disconnect plugs from DIS control unit by pressing on the surfaces on plug/control unit and connect together.

- Start engine and run at idle.

  Check idle speed and adjust if necessary.
  Setting value: 850 min^{-1}

- Check ignition timing and adjust if necessary.

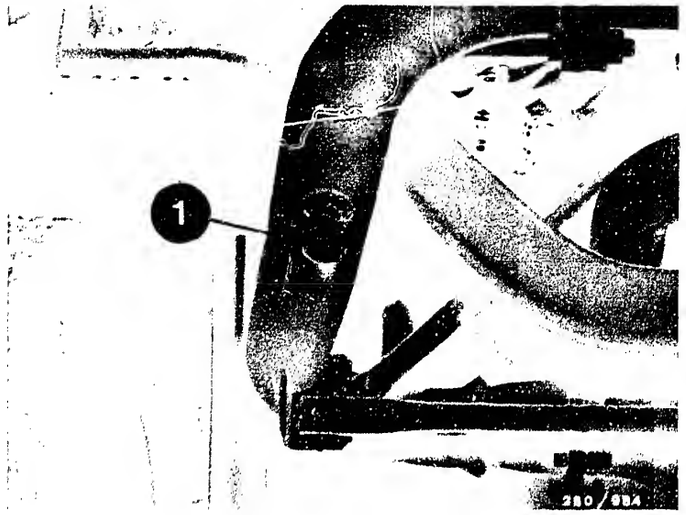
- Let engine idle for approx. 2 min.

- Check engine speed and adjust if necessary.
  Set value: 850 min^{-1}

- Switch off ignition.

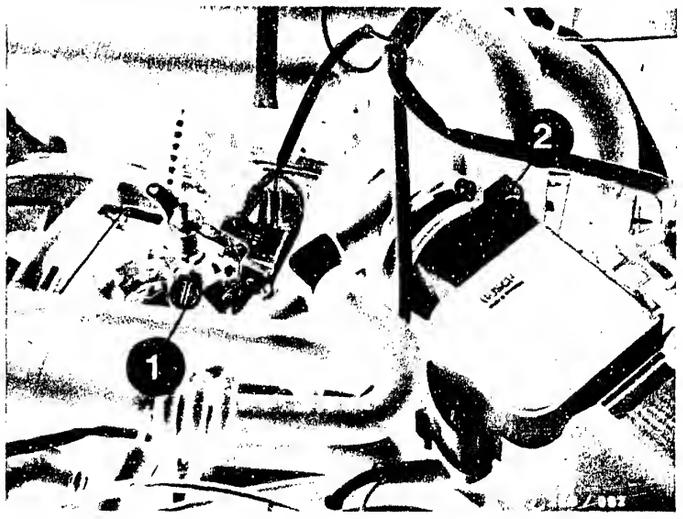
Continued on G23/G24

Continued on G19/G20



1=Exhaust sampling point

1=Idle-adjusting screw
2=CO adjusting screw



Rough igle, incorrect idle speed (continued)

yes

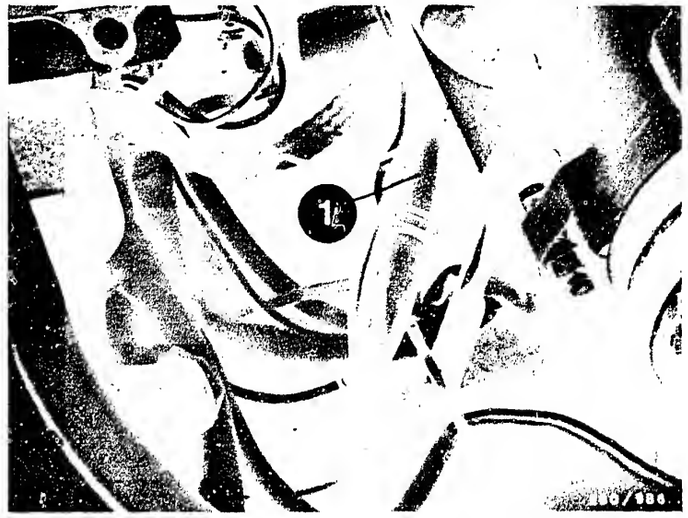
Checking the CO concentration

- Connect plugs on DIS control unit.
- Take apart plug connector for lambda sensor.
- Start engine and check CO concentration.
  Set value: 0.7 vol.%
  adjust if necessary at CO adjusting screw.
- Lock CO adjusting screw with new plug.
- Switch off ignition.
- Plug together connector for lambda sensor.
- Connect hose for crankcase ventilation on oil breather.
- Start engine and briefly raise engine speed (burst of throttle).
- Let engine idle and check idle adjustment:

  idle speed: 850...950 min^{-1}

  CO concentration: 0.3...1.1 vol.%

  Not within tolerance: replace DIS control unit/test lambda closed-loop control.



1=Lambda sensor plug connector

Continued on G23/G24

Continued on G21/G22

Rough idle, incorrect idle speed (continued)

yes

TESTING THE LAMBDA SENSOR AND LAMBDA CLOSED-LOOP CONTROL

- Engine at normal operating temperature

- Connect hose of CO tester to sampling point on left-hand exhaust pipe by means of screw-type sleeve V.A.G. 1506.
- With ignition off, take apart plug connector (1) for lambda sensor.
- Disconnect vacuum hose (2) from pressure regulator and seal off.
- Start engine; CO concentration rises to above 1.5 vol.%.
- Let engine run for at least 2 min.
- Plug together plug connector for lambda sensor. CO concentration must drop to

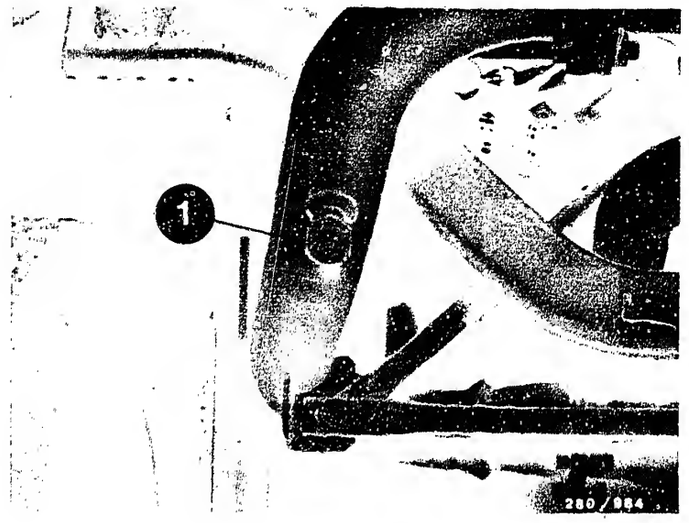
  0.7 ± 0.4 vol.%

If not, the following components may be defective:

- Lead from lambda sensor to control unit or control unit.
  Testing:
  Take apart lambda sensor plug connector and hold lead to control unit against ground.
  CO concentration must rise.
  Connect approx. 2 V to lead.
  CO concentration must drop.
- Lambda sensor (replace).

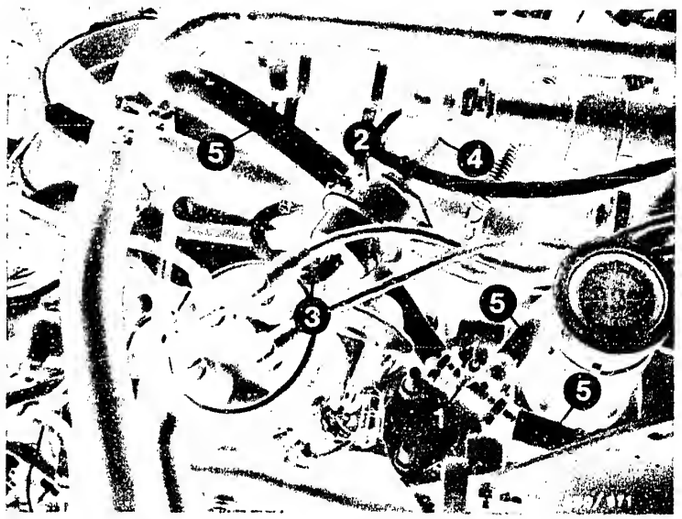
- Exhaust system leaking between catalytic converter and cylinder head (repair leak).

Continued on G23/G24



1=Exhaust sampling point

2=Pressure regulator
3=Vacuum hose to intake manifold



Rough idle, incorrect idle speed (continued)

For all vehicles:

If CO concentration too high, turn CO adjusting screw in air-flow sensor half a turn in a counter-clockwise direction (hexagon-socket-head cap screw AF 5 mm).

Check idle speed and CO concentration again. If necessary, make corrections in several steps. After adjusting, use new red plug (1 280 508 012).

yes

Trouble-shooting program completed for customer complaint

"Rough idle, incorrect idle speed".

Fault eliminated?

no

Further possibilities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).
- Engine not mechanically O.K. (compression valve setting, valve timing, worn camshaft).

POOR THROTTLE TAKE-UP

Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHOOTING

Ignition, engine etc.O.K.? — no → Eliminate faults in ignition and engine.

yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

yes

Continued on H3/H4

Poor throttle take-up (continued)

yes

Throttle valve closed?
- Throttle lever coming up against stop screw?
- Throttle cable free of tension?
- Throttle cable without kinks?
- Adjust throttle actuation?

no

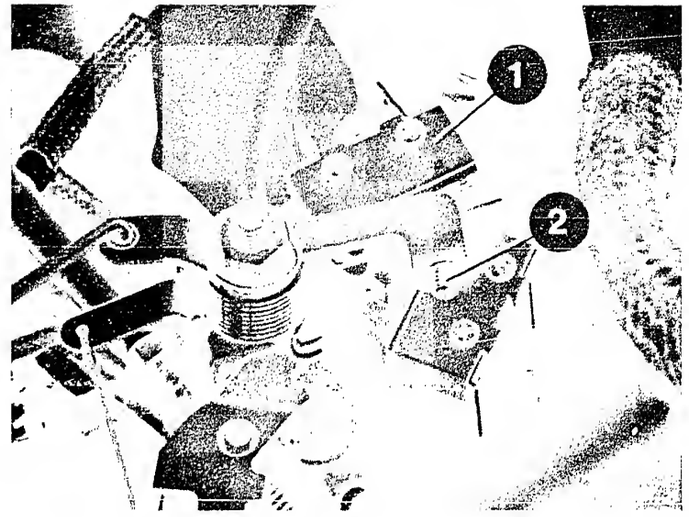
- Testing
  Check whether the throttle valve can be closed still further and whether the engine speed thereby drops.

- Adjusting the throttle valve:
  The throttle valve must come up against the stop screw with the throttle lever just before it sticks. Lock stop screw by means of lock nut.
- If throttle cable kinked - replace.

yes

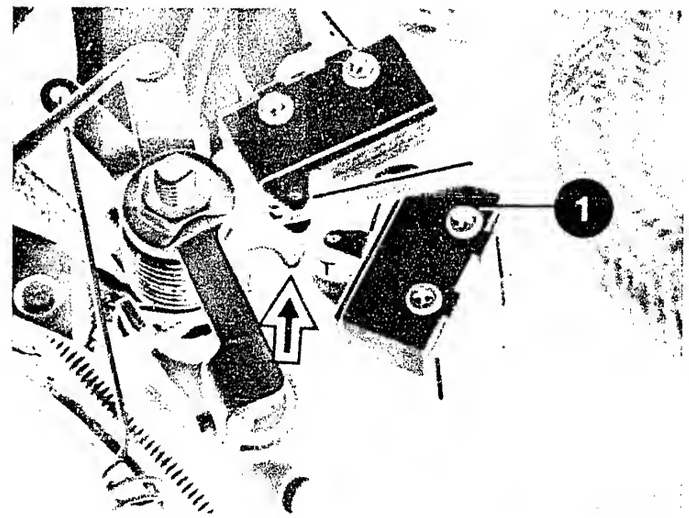
Continued on H7/H8

Continued on H5/H6



1=Idle switch
2=Adjusting screw

3=Full-load switch
Arrow=Cam plate



Poor throttle take-up (continued)

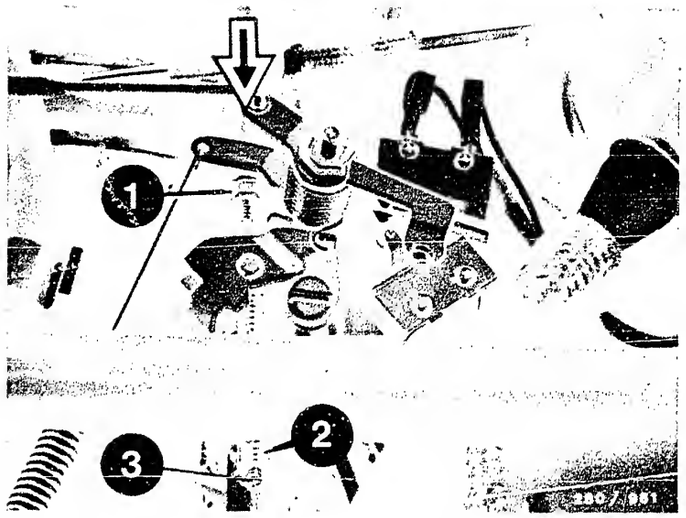
yes

- ADJUSTING THE THROTTLE ACTUATION

  The throttle actuation must be adjusted so that, with the throttle valve closed (idle), the actuating lever on the transmission is at the stop in the zero-throttle position. Otherwise the upshifts at medium speeds take place too late.

  Adjust the throttle actuation in the idle position (engine at normal operating temperature, throttle valve closed) as follows:

- loosen nut - 1.
- Remove overtravel spring - 2.
- Pull rod for throttle actuation in direction of arrow (zero-throttle position).
- Adjust end-piece - 3 - by turning with a screwdriver so that the stop face of the end-piece is up against the pin of the actuation shaft.
- Install overtravel spring - 2.
  Start the engine and check whether idle speed is obtained. If necessary, re-adjust by turning end-piece - 3.
- Lock end-piece with nut - 1.



Continued on H7/H8

Poor throttle take-up (continued)

yes

On US version only
Auxiliary-air device mechanically O.K.?
Free cross-section?
- cold - open?
- Warm - closed?
- Engine-speed drop when hose pinched off? (engine cold).

no

Testing:
- Visual examination of auxiliary-air device. Disconnect hoses and look down (possibly using a small mirror). When cold, the cross-section must be partially open; when the engine is warm it must be closed. If not, replace auxiliary-air device.

- Functional test of auxiliary-air device: With engine cold, pinch off hose to auxiliary-air device. Engine speed must drop. With the engine warm, pinch off hose to auxiliary-air device. Engine speed must not drop noticeably. If not, replace auxiliary-air device (pay attention to the direction of flow).

yes

On US version only
Electrical operation of auxiliary-air device (power supply, ground lead, resistance) O.K.?

no

Start engine.
- Voltage at plug min. 12 V. If not, check the following leads for continuity (set value approx. 0Ω):
- From term. 33 to central ground.
- From term. 34 to pump relay term. 87.
- Resistance of auxiliary-air device 20 ... 55 Ω (plug disconnected).

If the resistance is not within tolerance, replace the auxiliary-air device.

Continued on H9/H10

Arrow=Auxiliary-air device

Poor throttle take-up (continued)

yes

Air-flow sensor mechanically O.K.? — no

yes

Testing
Loosen clamp-type fasteners on air filter. Lift off top part of air filter.

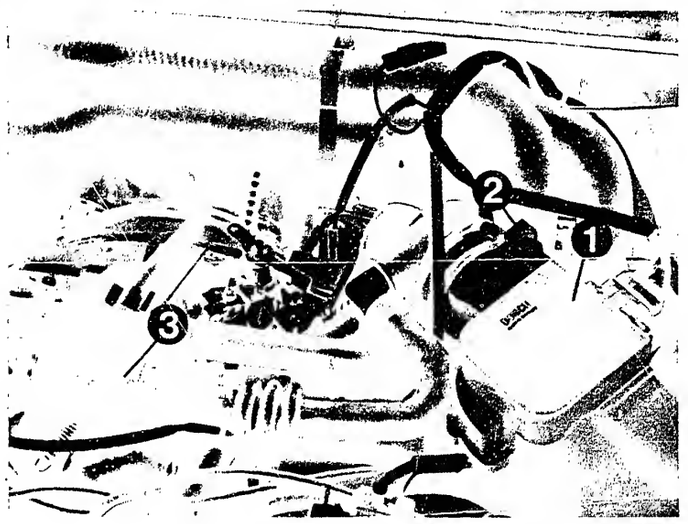
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.

- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

  The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
  Caution: after testing is completed, the air filter and the air-flow sensor must be re-assembled.

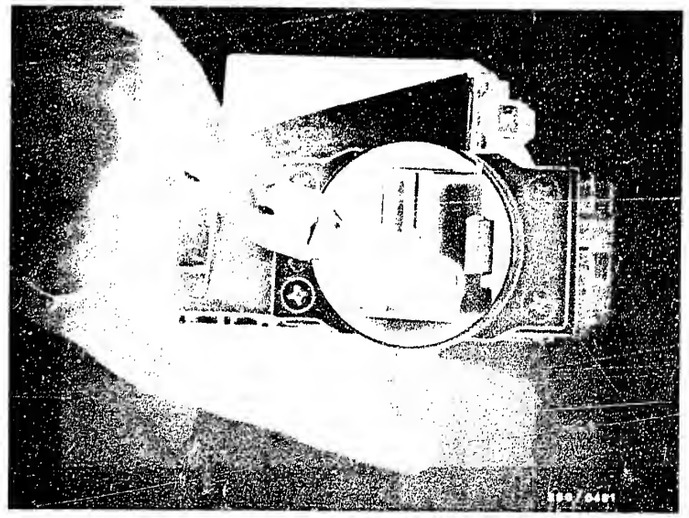
Continued on H15/H16

Continued on H11/H12



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Poor throttle take-up (continued)

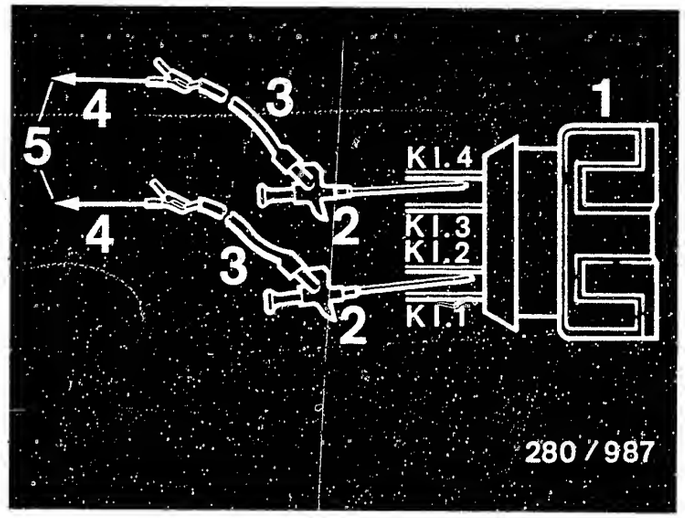
yes

Potentiometer test: (Noise test)

- Remove air-flow sensor. (Loosen clamp-type fasteners on air filter. Lift off top part of air filter. Loosen air-flow sensor fastening screws. Leave plug on). Set motor-tester to special input and, using the special lead, connect to air-flow sensor term. 2 (red clip) and term. 4 (black clip).

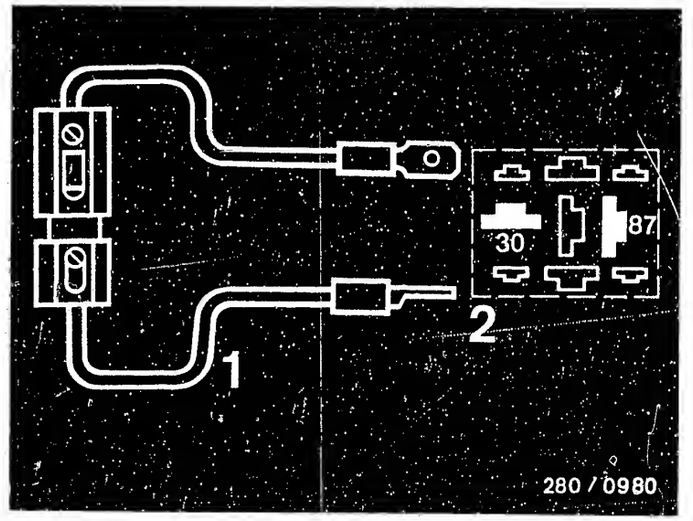
- Making the adapter lead:
  User fabrication: two approx. 1 m long leads approx. 1.0 mm² diameter. 2 measuring prods are fastened on one end; at the other end, strip off approx. 2 cm of insulation and connect the clamps of the special input connecting cables.

  Caution:
  Insulate bare connecting points on the adapter lead. (Danger of short circuit). Measure carefully into the plug of the air-flow sensor. Do not bend any spring contacts.
- Set control lever for image adjustment on motortester as far as it will go to the left (calibrated setting).
  Disconnect main relay. Insert jumper between term. 87 and term. 30 in the connection base. (Power supply to control unit).



1=Air-flow sensor plug
2=Clamp-on test prod
3=Adapter lead (user-fabricated)
4=Special input connecting cable
5=Motortester special input

1=Jumper with fuse holder and 10A fuse (user-fabricated)
2=Top view of connection base



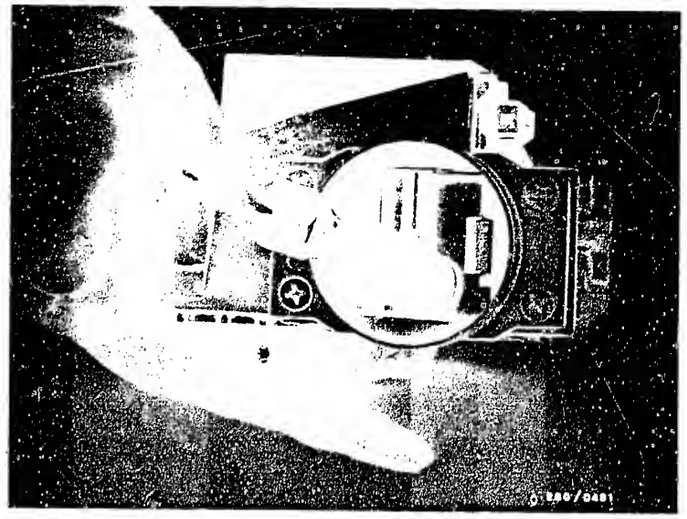
Continued on H15/H16

Continued on H13/H14

Poor throttle take-up (continued)

- Deflect air-flow sensor flap suddenly several times. A continuous stroke signal must be visible on the oscilloscope. If not, (see picture) - replace air-flow sensor.
  Put on rubber sleeve properly after testing.
  Connect all hoses and tighten. (Leaks).

  Caution: After testing, remove the jumper and connect the control relay.

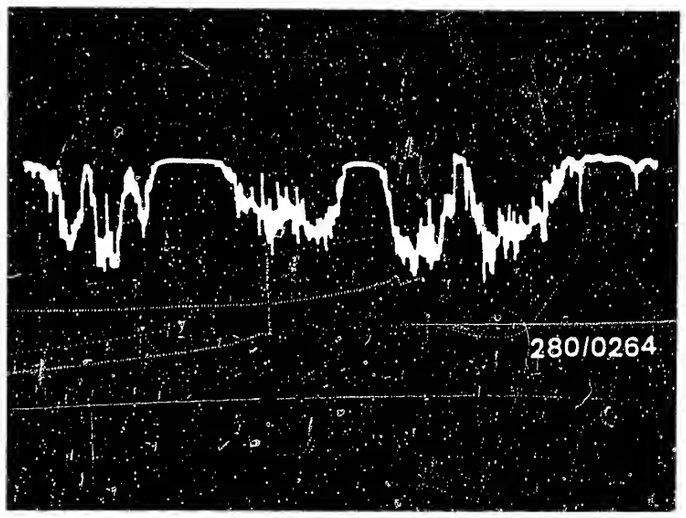


Opening the air-flow sensor flap

yes

Continued on H15/H16

Incorrect noise signal



Poor throttle take-up (continued)

yes

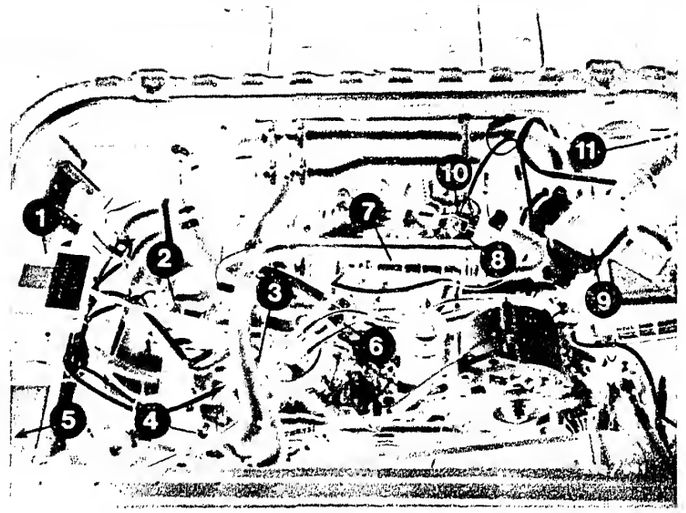
Are all hose lines and electrical lead connections correctly connected, not kinked or damaged?
Visual examination.
Air-intake system checked for leaks with 0.3 bar gauge pressure?

no

- Check whether hoses of air-intake system and of fuel line system are correctly connected, not kinked or damaged. If necessary, replace hoses. Eliminate leaks by new seals or by re-tightening the connecting screws.
- Leak test:
  Seal off the exhaust tail pipe. Loosen clamp-type fasteners on air filter. Lift off top part of air filter and seal off air-flow sensor duct. Disconnect hose after idle actuator (EU version) or auxiliary-air device (US version) and blow air (0.3 bar gauge pressure) into the intake manifold with a compressed-air gun. Seal off connection port on idle actuator/auxiliary-air device. Fully open throttle valve. Brush or spray all joints with soapy water. Leaks may also occur at the following points on the engine: oil dipstick not securely inserted, defective cap seal on oil filler neck etc.
  Bubbling or foaming indicates a leak.

yes

Continued on H17/H18



EU version (US version similar)
1 =Main and pump relays
2 =Injection valves
3 =Central ground
4 =Temperature sensor II
5 =Control unit
6 =Pressure regulator
7 =Idle actuator
8 =Full-load switch
9 =Air-flow sensor
10=Idle switch
11=Idle controller
(behind a cover)

Poor throttle take-up (continued)

yes

EU version:
Idle speed:
820...920 min^{-1}

CO concentration
(with engine at normal operating temperature):
0.8...1.8 vol.%CO

US version:
Idle speed

800...900 min^{-1}

CO concentration
(with engine at normal operating temperature, lambda sensor connected and DIS connected):

0.3...1.1 vol.%CO

Idle speed and CO concentration correctly adjusted?

yes

Continued on J3/J4

no

Idle speed and CO adjustment
EU version

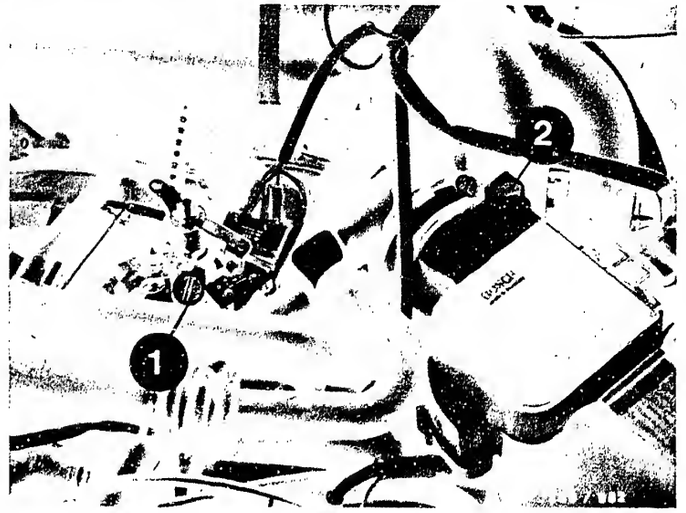
- Conditions for testing and adjusting
- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not be operating when testing/adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Ignition timing O.K.
- Switch for overrun cutoff/idle closed.
- Idle-speed stabilization O.K. (with ignition on valve must vibrate and hum).

- Test and adjust the idle speed and CO concentration
- Take apart terminal 1 plug connector (arrow, bottom picture).
- Test the idle speed and CO concentration and, if necessary, adjust the set value (average value) by alternately turning the adjusting screws.

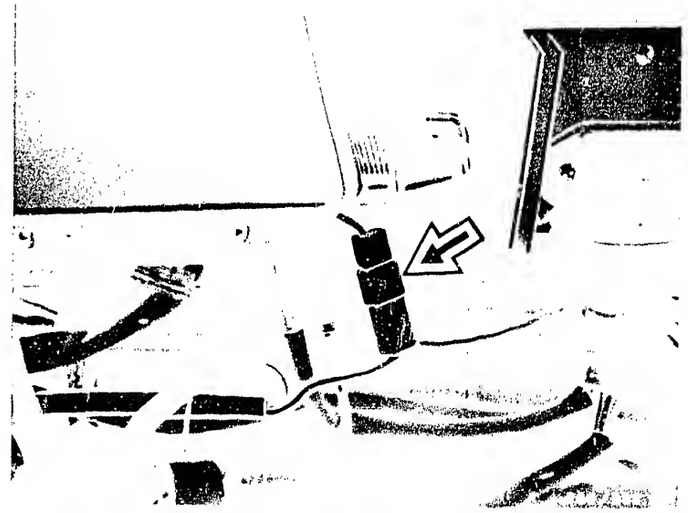
  Set values:
  Idle speed 870 min^{-1}
  CO concentration 1.3 vol.%CO
- Plug together the plugs of terminal 1 plug connector

- After correcting, lock CO adjusting screw with red anti-tamper cap.

Continued on H19/H20



1=Idle-adjusting screw
2=CO adjusting screw



Poor throttle take-up (continued)

yes

Note:
After the CO adjustment, the hose for the crankcase ventilation must be re-connected. If the CO concentration now rises, this is not due to an incorrect adjustment, but to enriching from the crankcase as a result of oil dilution if the engine is operated predominantly over short distances. With lengthy, brisk long-distance trips the fuel content in the oil is reduced and the CO concentration comes back to normal.

- Ignition timing correctly adjusted.
  Adjust if necessary.
- With idle stabilization connected and retard hose connected, idle speed and CO concentration must comply with the set values.

If not:
- incorrect DIS control unit
- vacuum unit - retard - or hose connection to vacuum unit defective.

US version

- Conditions for testing and adjusting

- Engine at normal operating temperature

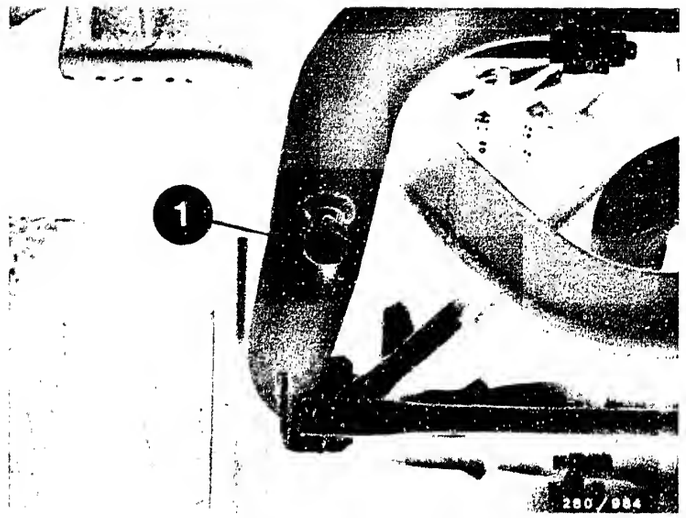
- Electrical devices switched off (radiator fan must not operate when testing/adjusting).

- Hose for crankcase ventilation disconnected from oil breather and plugged tight.

- Switch for overrun cutoff/idle closed.

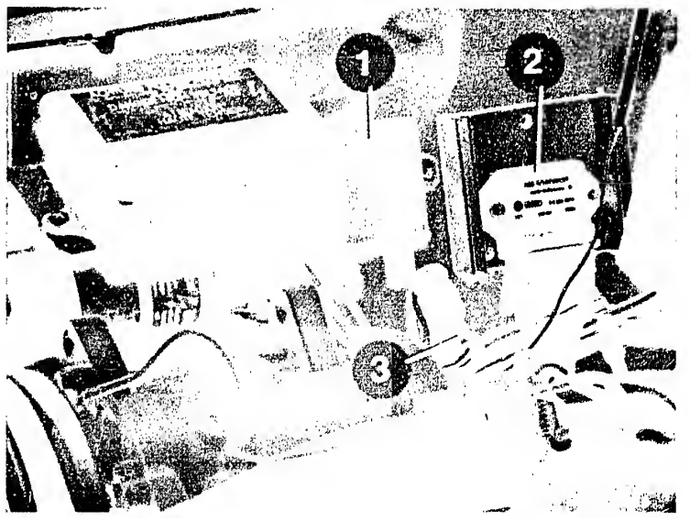
Continued on J3/J4

Continued on H21/H22



1=Exhaust sampling point

1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected.



Poor throttle take-up (continued)

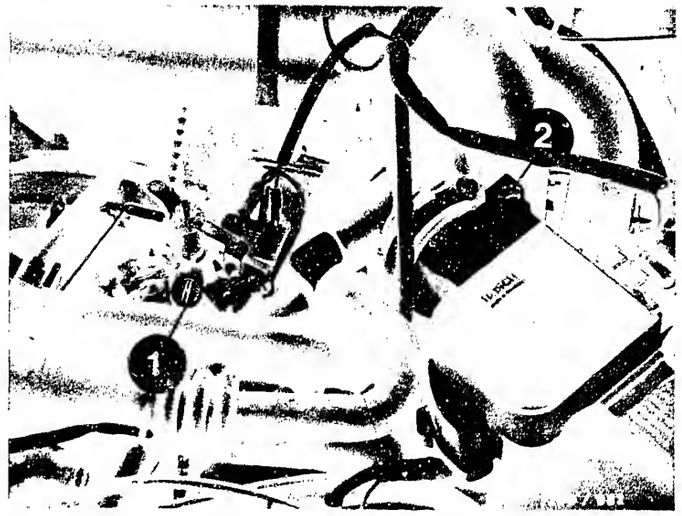
yes

- Testing and adjusting the idle speed and CO concentration
- Connect testers for ignition timing and engine speed.
- Connect hose of CO tester to the sampling point on the left-hand exhaust pipe by means of screw-type sleeve V.A.G. 1506.
- Keep to the sequence of testing/adjusting operations.
- Check the ignition timing and adjust if necessary.
- Disconnect plugs from DIS control unit by pressing on the surfaces on plug/control unit and connect together.
- Start engine and run at idle.

  Check idle speed and adjust if necessary.
  Setting value: 850/min^{-1}
- Check ignition timing and adjust if necessary.
- Let engine idle for approx. 2 min.
- Check engine speed and adjust if necessary.
  Set vaolue: 850 min^{-1}
- Switch off ignition.

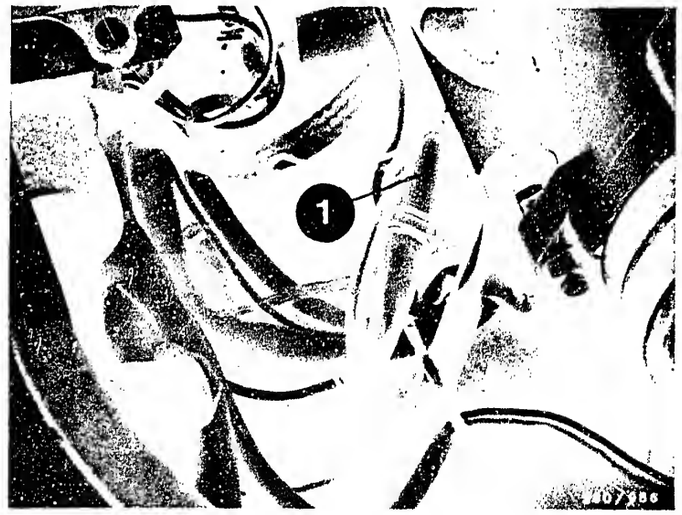
Continued on J3/J4

Continued on H23/H24



1=Idle-adjusting screw
2=CO adjusting screw

1=Lambda sensor plug connector



Poor throttle take-up (continued)

yes

Checking the CO concentration

- Connect plugs on DIS control unit.
- Take apart plug connector for lambda sensor.
- Start engine and check CO concentration.
  Set value: 0.7 vol.%
  adjust if necessary at CO adjusting screw.
- Lock CO adjusting screw with new plug.
- Switch off ignition.
- Plug together connector for lambda sensor.
- Connect hose for crankcase ventilation on oil breather.
- Start engine and briefly raise engine speed (burst of throttle).
- Let engine idle and check idle adjustment:

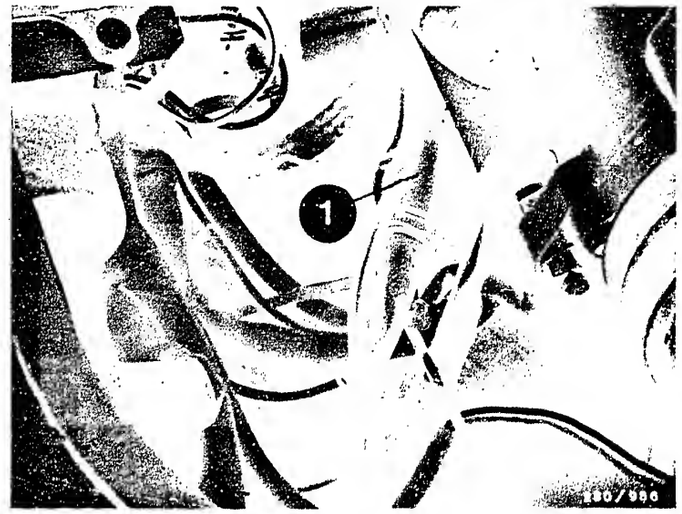
  idle speed: 850...950 min^{-1}

  CO concentration: 0.3...1.1 vol.%

  Not within tolerance: replace DIS control unit/test lambda closed-loop control.

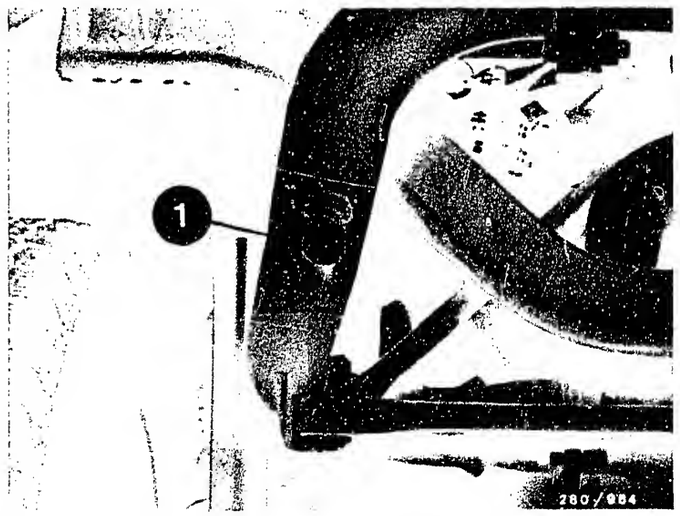
Continued on J3/J4

Continued on J1/J2



1=Lambda sensor plug connector

1=Exhaust sampling point



Poor throttle take-up (continued)

yes

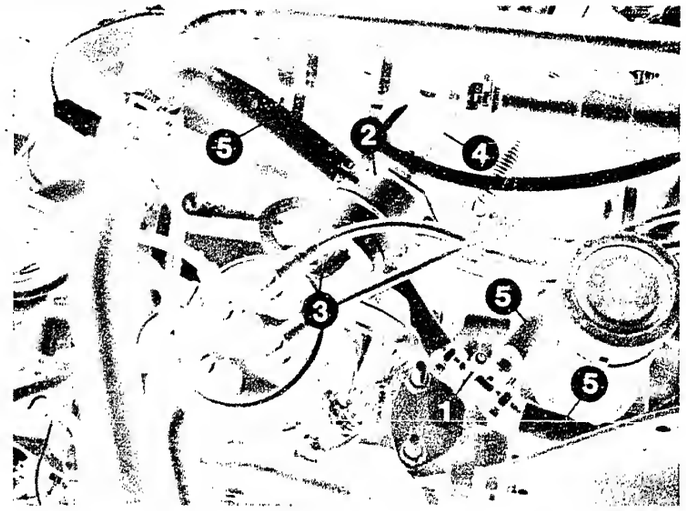
TESTING THE LAMBDA SENSOR AND LAMBDA CLOSED-LOOP CONTROL

- Engine at normal operating temperature
- Connect hose of CO tester to sampling point on left-hand exhaust pipe by means of screw-type sleeve V.A.G. 1506.
- With ignition off, take apart plug connector (1) for lambda sensor.
- Disconnect vacuum hose (2) from pressure regulator and seal off.
- Start engine; CO concentration rises to above 1.5 vol.%.
- Let engine run for at least 2 min.
- Plug together plug connector for lambda sensor. CO concentration must drop to

  0.7 ± 0.4 vol.%

  If not, the following components may be defective:
- Lead from lambda sensor to control unit or control unit.
  Testing:
  Take apart lambda sensor plug connector and hold lead to control unit against ground.
  CO concentration must rise.
  Connect approx. 2 V to lead.
  CO concentration must drop.
- Lambda sensor (replace).

- Exhaust system leaking between catalytic converter and cylinder head (repair leak).



2=Pressure regulator
3=Vacuum hose to intake manifold

Continued on J3/J4

Poor throttle take-up (continued)

yes

Trouble-shooting program completed for customer complaint

"Poor throttle take-up".

Fault eliminated?

no

Further possibilities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).
- Engine not mechanically O.K. (compression, valve setting, valve timing, worn camshaft).

ENGINE MISSING UNDER ALL OPERATING CONDITIONS

Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHOOTING

Ignition, engine etc.O.K.? — no → Eliminate faults in ignition and engine.

yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

yes

Continued on J7/J8

Engine missing under all operating conditions (continued)

yes

Alternator with regulator O.K.?
- No engine missing, no voltage peaks visible on motortester.

no →
- With the engine off, disconnect plug from alternator. Start engine. If missing stops, test alternator and regulator. Voltage peaks are visible on the ignition oscilloscope.

yes

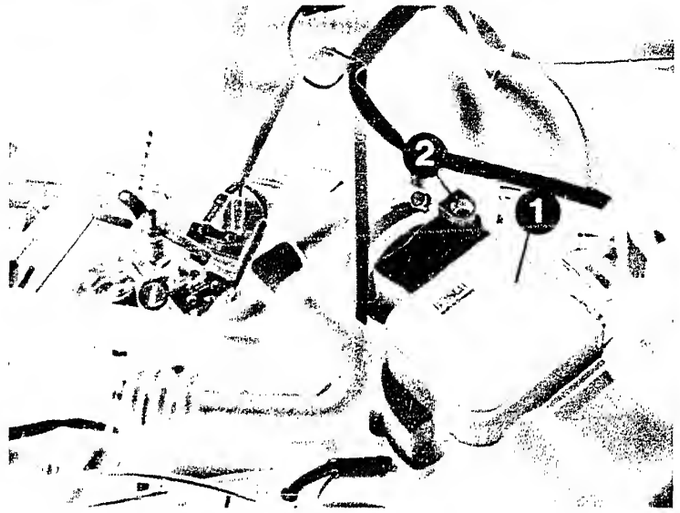
Air-flow sensor mechanically O.K.?

no →

Testing:
Loosen clamp-type fasteners on air-filter. Lift off top part of air filter.
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.
- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.
  The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
  Caution: after testing is completed, the air filter and the air-flow sensor must be re-assembled.

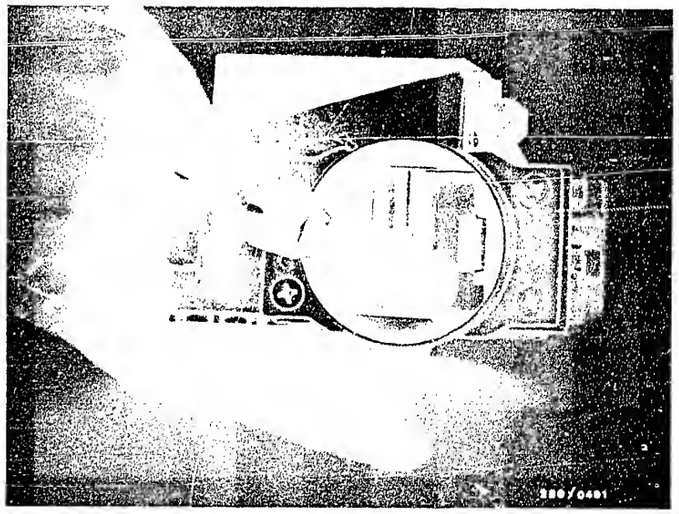
yes

Continued on J9/J10



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Engine missing under all operating conditions (continued)

yes

Fuel delivery of electric fuel pump O.K.?

Test specification:
min. 550 cm³/30 s

no

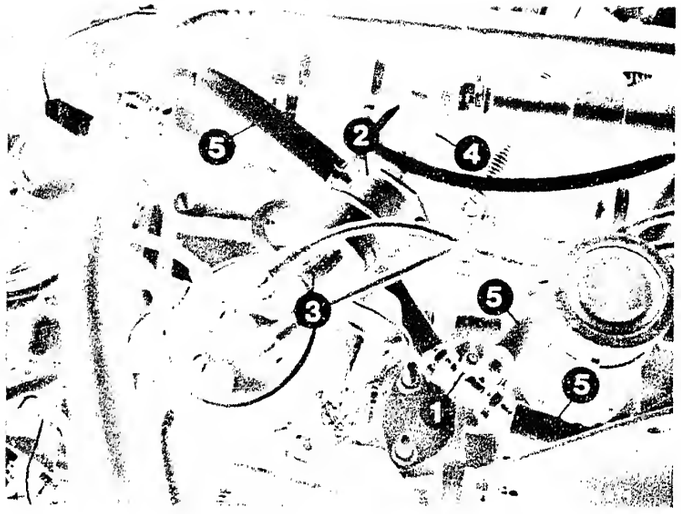
- Measuring the fuel delivery:
  For testing, disconnect joint between fuel return connection (on pressure regulator) and fuel return line (to fuel tank).
  Connect hose and lead into a 5 l vessel with graduated scale. Disconnect pump relay.
  Insert jumper between term. 87 and term. 30 in the connection base. Electric fuel pump must operate.
  Test specification:
  min.: 550 cm³/30 s

  Caution:
  Jumper must be removed again after testing is completed.
  Remedy if test specification not reached:
- Fuel filter clogged - replace.
- Voltage at connection terminals of electric fuel pump with engine running: min. 12 V. If not, clean contacts. If necessary, eliminate poor ground connection. Replace leads.
- Pressure regulator defective - replace.
- If fuel delivery too low, replace electric fuel pump.

  Testing completed: Remove jumper from connection base and connect pump relay. Re-connect fuel lines.

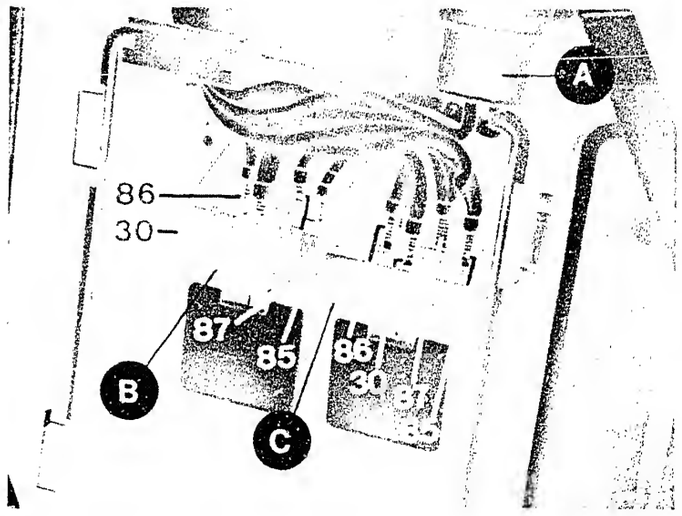
yes

Continued on J11/J12



2=Pressure regulator
4=Fuel return line

C=Pump relay



Engine missing under all operating conditions (continued)

yes

Control unit O.K.?
- Engine running without missing?
- Plug-in connections at control-unit plug O.K.?

no →
Let engine run.
- Shake control unit lightly and move control-unit plug. Watch for engine missing.
- Repair plug-in connection at control-unit plug/ replace defective control unit.

yes

Engine coughing on overrun?
- Exhaust system leak-tight?

no →
- Check exhaust system for leaks.

yes

Engine coughing on overrun?
Throttle valve closed?
- Throttle lever coming up against stop screw?
- Throttle cable free of tension?
- Throttle cable not kinked?

no →
- Testing:
Check whether the throttle valve can be closed still further and whether the engine speed thereby drops.
- Adjusting the throttle valve:
The throttle valve must come up against the stop screw with the throttle lever just before it sticks. Lock stop screw by means of lock nut.
- If throttle cable kinked - replace.
Adjust the throttle actuation in the idle position (engine at normal operating temperature,throttle valve closed) as follows:
- Loosen nut - 1.
- Remove overtravel spring - 2.
- Pull rod for throttle actuation in direction of arrow (zero-throttle position).
- Adjust end-piece - 3 - by turning with a screw-driver so that the stop face of the end-piece is up against the pin of the actuation shaft.
- Install overtravel spring - 2. Start the engine and check whether idle speed is obtained. If necessary, re-adjust by turning end-piece -3.
- Lock end-piece with nut - 1.

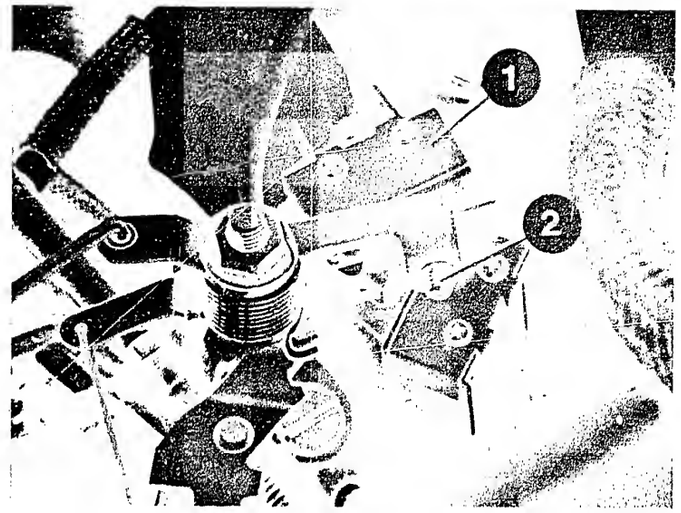
yes

Engine coughing on overrun?
Throttle-valve switch correctly adjusted?
- Idle contact closing?
- Microswitch clicking audibly?

no →

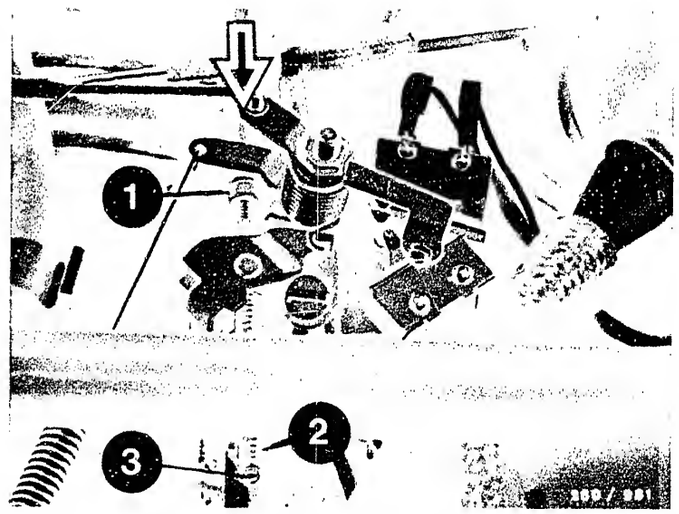
yes

Continued on J13/J14



1=Idle switch
2=Adjusting screw

1=Nut
2=Overtravel spring
3=End-piece



Engine missing under all operating conditions (continued)

yes

Engine coughing on overrun?
Overrun cutoff O.K.?

- Control unit functioning O.K.?
- Reinstatement speed O.K.?
  EU version
  warm: 975 min^{-1}
  US version
  warm: 1100 min^{-1}

no

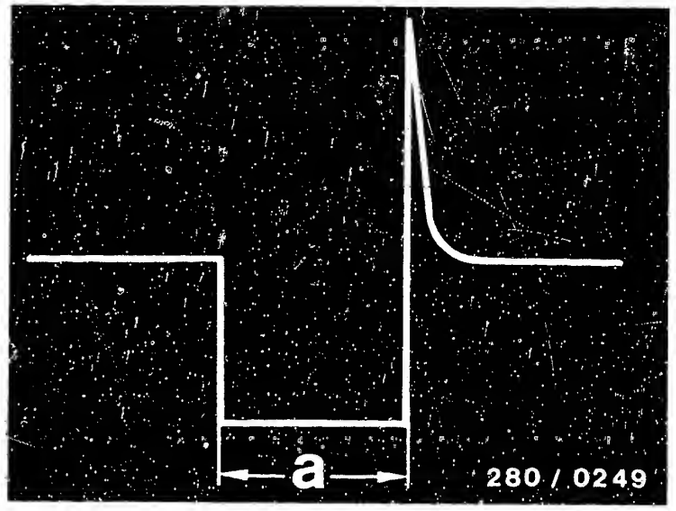
- Testing the operation of the overrun cutoff:
  Connect test lead as follows:
  The two-pole plug connections of the test lead are connected between an injection valve and its connecting lead. Of the other two connection terminals of the test lead, only one connection terminal need be connected to the special input on the motortester. If correctly connected, the pattern shown opposite is visible on the oscilloscope.
  Observe oscilloscope.
- Slowly increase engine speed to 3000 min^{-1}. Injection pulses must be visible on the oscilloscope. Take foot off accelerator. (Idle position). No more injection pulses.
- As of approx. 975 min^{-1} EU version or 1100 min^{-1} US version injection pulses must be visible again.

  The cutoff speed is at approx. 1535 min^{-1}.

  If incorrect, replace control unit.

yes

Continued on J15/J16



Injection pulse of a switched output stage
(measured at injection valve)
a=Pulse length (dependent on engine load)

Engine missing under all operating conditions (continued)

Injections valves tested for proper operation?
Injection signals checked for missing?
- Injection pulses without interference or missing?
- Correct routing of leads?
- No loose contacts in plug-in connections?

no →

- Connect test lead as follows:
  The two-pole plug connections of the test lead are connected between an injection valve and its connecting lead. Of the other two connection terminals of the test lead, only one need be connected to the special input of the motortester.
- If correctly connected, the pattern shown opposite is visible on the oscilloscope.
  Using the test lead it is possible to test the injection pulses at the injection valves with an ignition oscilloscope with the engine running. If the pattern shown opposite is not obtained or if there are differences (interference, missing etc.), the other injection valves should also be checked.
- In case of interference: check routing of leads.
- In case of missing: eliminate loose contacts in leads or in plug-in connections.

yes ↓

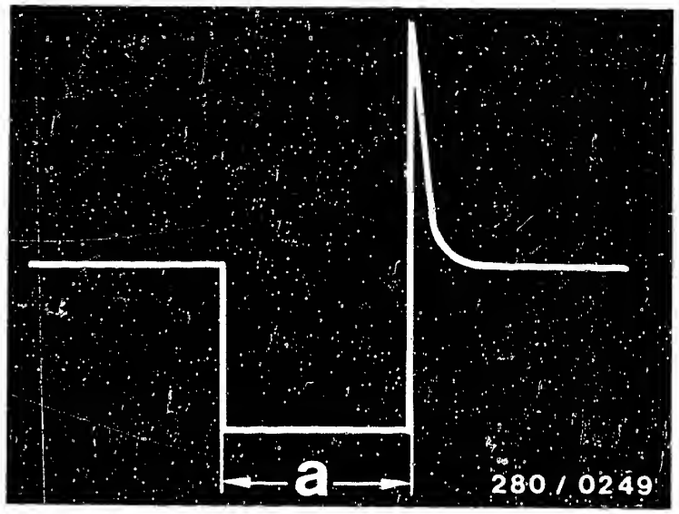
Injection valve mechanically O.K.?
- Does engine speed drop when individual injection-valve connectors are pulled off?

no →

- With the engine running, disconnect injection-valve connectors individually, one after the other, from the injection valves and plug on again.
  Engine speed must drop if injection valve O.K.

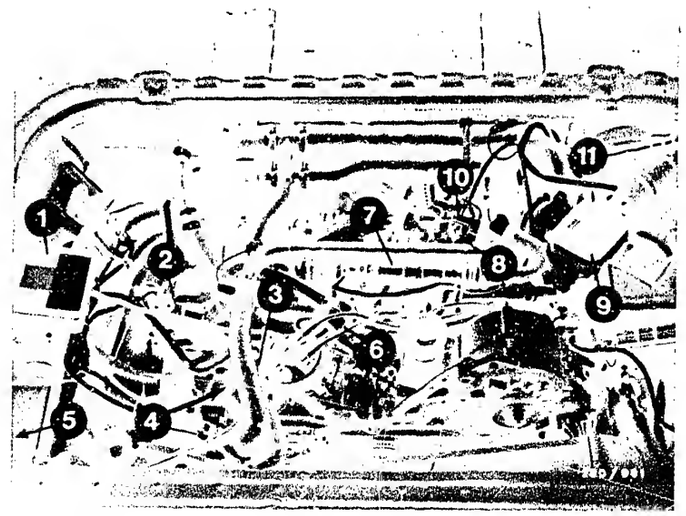
yes ↓

Continued on J17/J18



Injection pulses of a switched output stage
(measured at the injection valve)
a=Pulse length (dependent on engine load)

2=Injection valves



Engine missing under all operating conditions (continued)

yes

Solenoid-operated injection valves O.K.?

- Removal and installation

no

- Removal

Remove fuel-distribution pipe with injection valves.

- Loosen fastening screws on fuel-distribution pipe and on injection valves.
- Pull injection valves in pairs and carefully out of the cylinder head.
  If injection valves defective on one side, loosen fuel-distribution pipe.
  Caution: Make sure that no fuel gets onto hot parts of the engine.
- Pull off electrical connection.
- Break open hose-termination sleeve on fuel-distribution pipe.
- Cut open hose in longitudenal direction with a soldering iron and pull off injection valve.
  Caution: Catch any escaping fuel. Do not allow to drip onto hot poarts of the engine.
  Warning: Before installing, grease the rubber seals at the valve mouth sleeve only lightly (silicone grease Ft 2 v 1). The other injection-valve parts must remain grease-free.

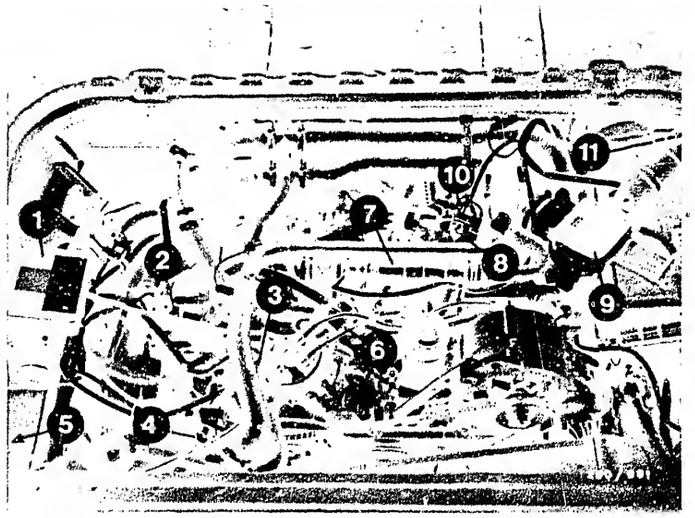
- Installation

- Plug on hose-termination sleeve (fuel-distribution pipe).
- Plug on new injection valve (watch for leaks).

Install the other components so as to re-establish the original conditions.

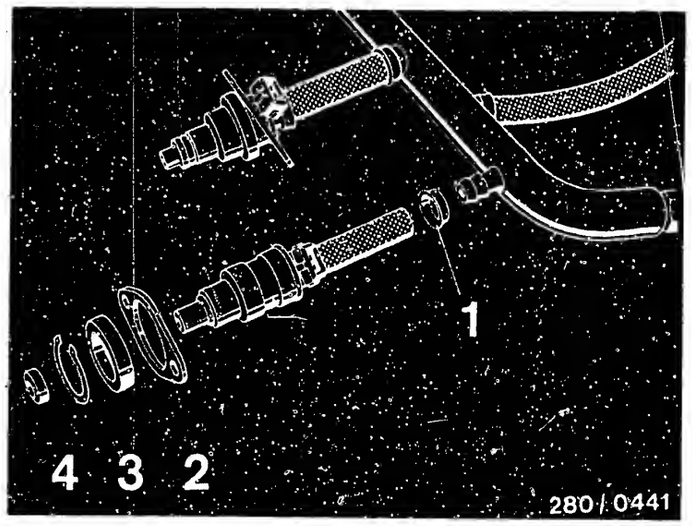
yes

Continued on J19/J20



2=Injection valves

similar to VW Type 25
1=Hose-termination sleeve
2=Holder
3=Rubber seal
4=Retainer



Engine missing under all operating conditions (continued)

yes

EU version:
Idle speed:
820...920 min^{-1}

CO concentration
(with engine at normal operating temperature):
0.8...1.8 vol.%CO

US version:
Idle speed

800...900 min^{-1}

CO concentration
(with engine at normal operating temperature, lambda sensor connected and DIS connected):

0.3...1.1 vol.%CO

Idle speed and CO concentration correctly adjusted?

yes

Continued on K5/K6

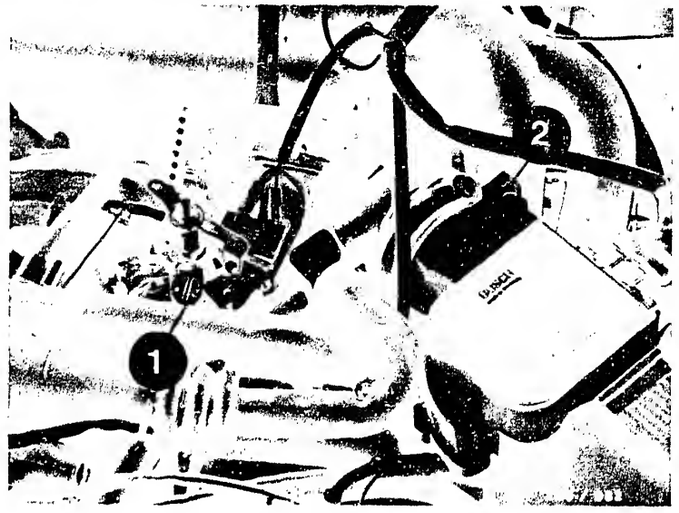
no

Idle speed and CO adjustment
EU version

- Conditions for testing and adjusting
- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not be operating when testing/adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Ignition timing O.K.
- Switch for overrun cutoff/idle closed.
- As of 7.84 model only: disconnect vacuum hose from retard unit of ignition distributor and seal off.
- As of 7.84 model only: disconnect plugs from DIS control unit and plug together.
- Idle-speed stabilization O.K.
(with ignition on valve must vibrate and hum).

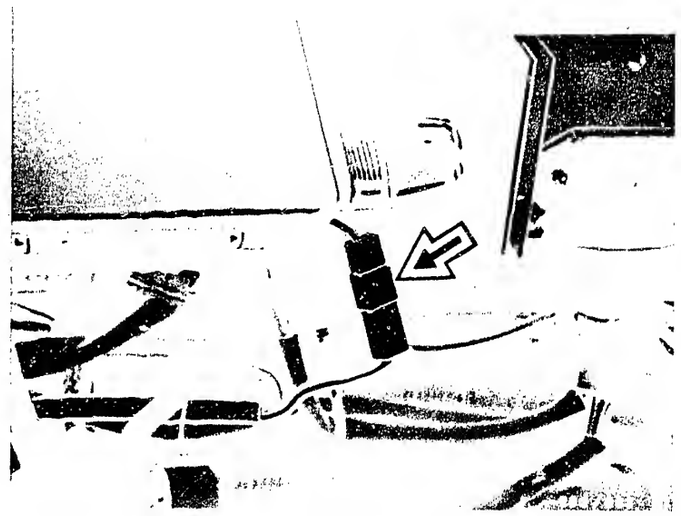
- Test and adjust the idle speed and CO concentration.
- Take apart terminal 1 plug connector (arrow, bottom picture).
- Test the idle speed and CO concentration and, if necessary, adjust the set value (average value) by alternately turning the adjusting screws.
Set values:
Idle speed 880 min^{-1}
CO concentration 1.3 vol.%CO
- Plug together the plugs of terminal 1 plug connector.
- After correcting, lock CO adjusting screw with red anti-tamper cap.

Continued on J21/J22



1=Idle-adjusting screw
2=CO adjusting screw

Arrow=Term. 1 plug connector



Engine missing under all operating conditions (continued)

yes

Note:
After the CO adjustment, the hose for the crankcase ventilation must be re-connected. If the CO concentration now rises, this is not due to an incorrect adjustment, but to enriching from the crankcase as a result of oil dilution if the engine is operated predominantly over short distances.

With lengthy, brisk long-distance trips the fuel content in the oil is reduced and the CO concentration comes back to normal

• as of 7.84 model only:

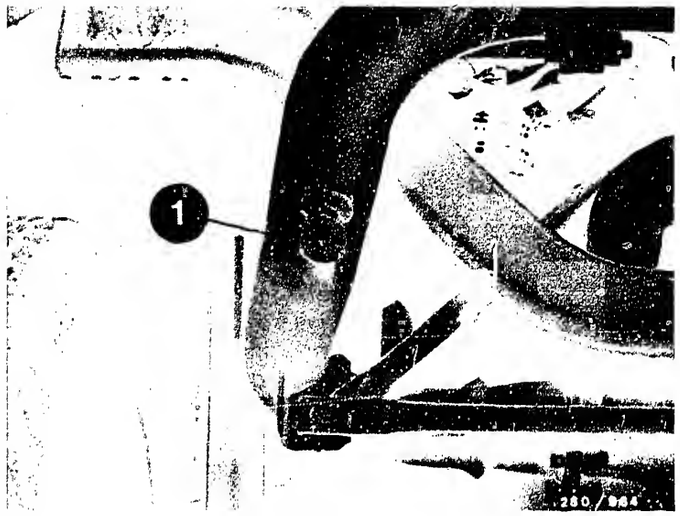
- Ignition timing correctly adjusted. Adjust if necessary.

With idle stabilization connected and retard hose connected, idle speed and CO concentration must comply with the set values.

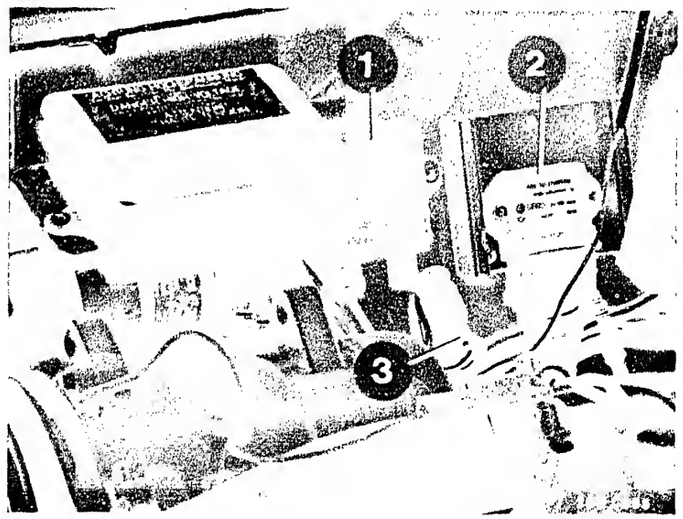
If not:
- incorrect DIS control unit
- vacuum unit - retard - or hose connection to vacuum unit defective.

Continued on K5/K6

Continued on J23/J24



1=Exhaust sampling point



1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected.

Engine missing under all operating conditions (continued)

US version

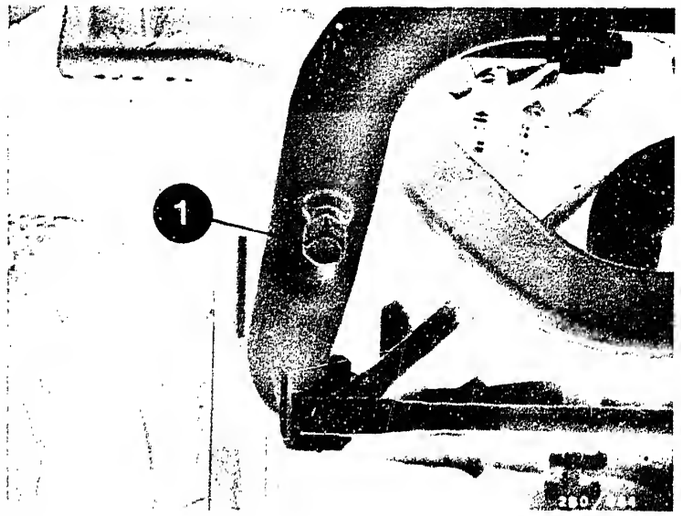
- Conditions for testing and adjusting
- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not operate when testing/adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Switch for overrun cutoff/idle closed.
- Testing and adjusting the idle speed and CO concentration
- Connect testers for ignition timing and engine speed.

yes

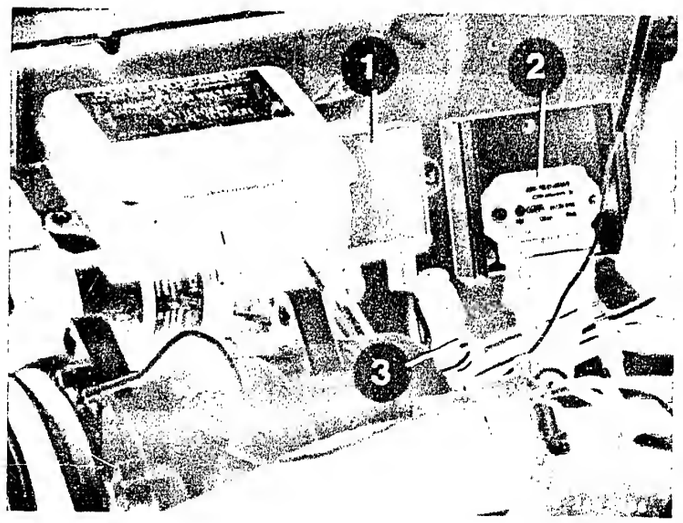
- Connect hose of CO tester to the sampling point on the left-hand exhaust pipe by means of screw-type sleeve V.A.G 1506.
- Keep to the sequence of testing/adjusting operations.
- Check the ignition timing and adjust if necessary.
- Disconnect plugs from DIS control unit by pressing on the surfaces on plug/control unit and connect together.
- Start engine and run at idle.
- Check idle speed and adjust if necessary.
  Setting value: 850 min^{-1}
- Check ignition timing and adjust if necessary.

Continued on K5/K6

Continued on K1/K2



1=Exhaust sampling point



1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected

Engine missing under all operating conditions (continued)

- Let engine idle for approx. 2 min.

- Check engine speed and adjust if necessary.
  Set value: 850 min^{-1}

- Switch off ignition.

Checking the CO concentration

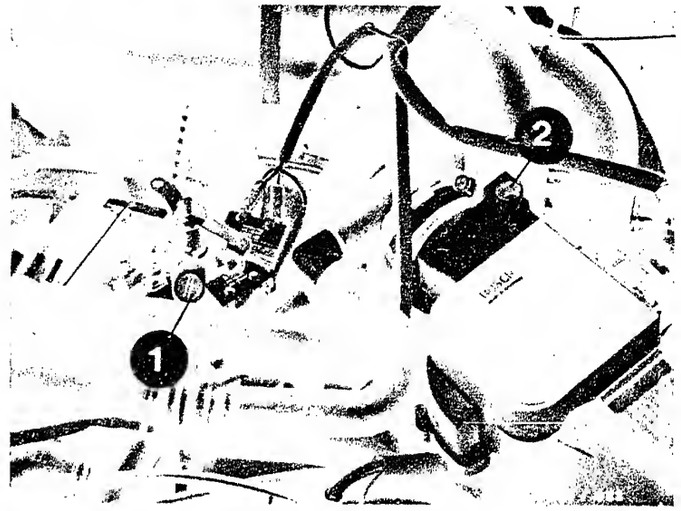
- Connect plugs on DIS control unit.
- Take apart plug connector for lambda sensor.
- Start engine and check CO concentration.
  Set value: 0.7 vol.%
  adjust if necessary at CO adjusting screw.
- Lock CO adjusting screw with new plug.
- Switch off ignition.
- Plug together connector for lambda sensor.
- Connect hose for crankcase ventilation on oil breather.
- Start engine and briefly raise engine speed (burst of throttle).
- Let engine idle and check idle adjustment:
  Idle speed: 850...950 min^{-1}
  CO concentration: 0.3...1.1 vol.%

Not within tolerance: replace DIS control unit/test lambda closed-loop control.

yes

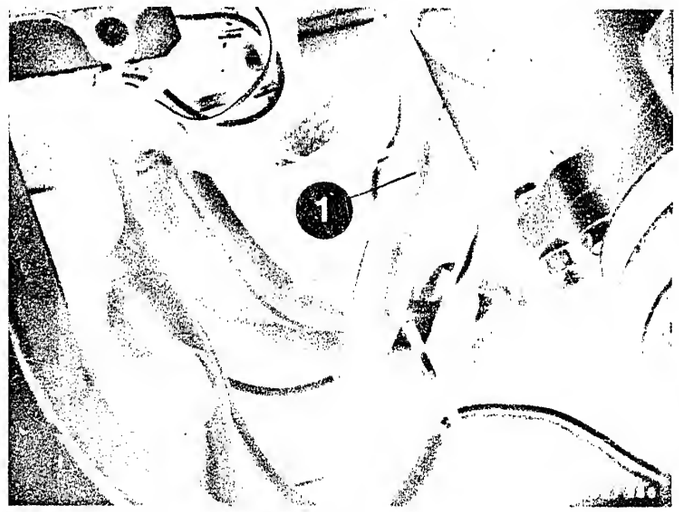
Continued on K5/K6

Continued on K3/K4



1=Idle-adjusting screw
2=CO adjusting screw

1=Lambda sensor plug connector



Engine missing under all operating conditions (continued)

TESTING THE LAMBDA SENSOR AND LAMBDA CLOSED-LOOP CONTROL

- Engine at normal operating temperature
- Connect hose of CO tester to sampling point on left-hand exhaust pipe by means of screw-type sleeve V.A.G. 1506.
- With ignition off, take apart plug connector (1) for lambda sensor.
- Disconnect vacuum hose (2) from pressure regulator and seal off.
- Start engine; CO concentration rises to above 1.5 vol.%.
- Let engine run for at least 2 min.
- Plug together plug connector for lambda sensor. CO concentration must drop to

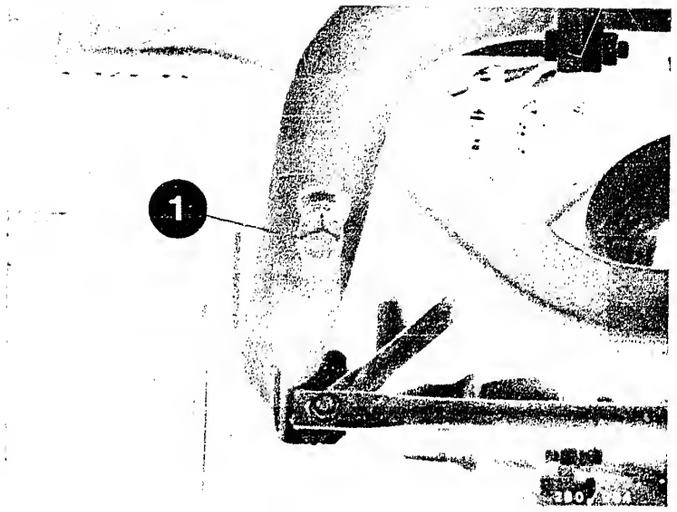
  0.7 ± 0.4 vol.%

  If not, the following components may be defective:
- Lead from lambda sensor to control unit or control unit.
  Testing:
  Take apart lambda sensor plug connector and hold lead to control unit against ground.
  CO concentration must rise.
  Connect approx. 2 V to lead.
  CO concentration must drop.
- Lambda sensor (replace).

- Exhaust system leaking between catalytic converter and cylinder head (repair leak).

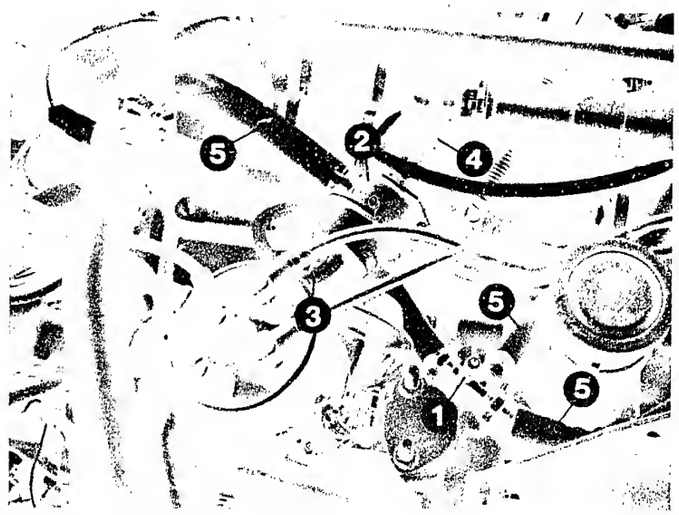
yes

Continued on K5/K6



1=Exhaust sampling point

2=Pressure regulator
3=Vacuum hose to intake manifold



Engine missing under all operating conditions (continued)

For all vehicles:

If CO concentration too high, turn CO adjusting screw in air-flow sensor half a turn in a counter-clockwise direction (hexagon-socket-head cap screw AF 5 mm).

Check idle speed and CO concentration again. If necessary, make corrections in several steps. After adjusting, use new red plug (1 280 508 012).

yes

Trouble-shooting program completed for customer complaint

"Engine missing under all operating conditions".

Fault eliminated?

no

Further possibilities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).
- Engine not mechanically O.K. (compression valve setting, valve timing, worn camshaft).

FUEL CONSUMPTION TOO HIGH

Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHOOTING

Ignition, engine etc. O.K.? — no → Eliminate faults in ignition and engine.

↓ yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

↓ yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

↓ yes

Continued on K9/K10

Fuel consumption too high (continued)

yes

Have all brakes released fully? — no → Adjust handbrake/drum brake so that there is no friction.

yes

Injection valve mechanically O.K.?
- Does engine speed drop when individual injection-valve connectors are pulled off? — no → With the engine running, disconnect injection-valve connectors individually one after the other from the injection valves and plug on again. Engine speed must drop if injection valve O.K.

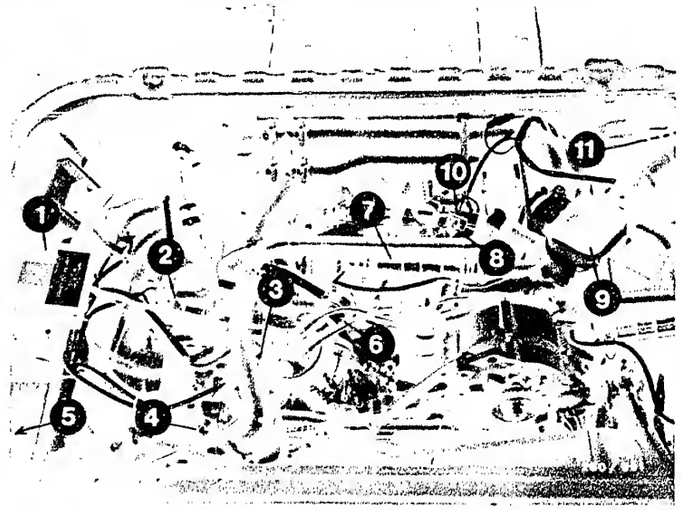
yes

Injection valves leak-tight? — no →
- Testing the injection valves for leaks
- Remove fuel-distribution pipes (left and right) with injection valves: Remove injection valves in pairs.
  Pull the two injection valves simultaneously and carefully out of the cylinder head. Fuel lines remain connected.

yes

Continued on K13/K14

Continued on K11/K12



2=Injection valves

1=Fuel-distribution pipe
2=Injection valves

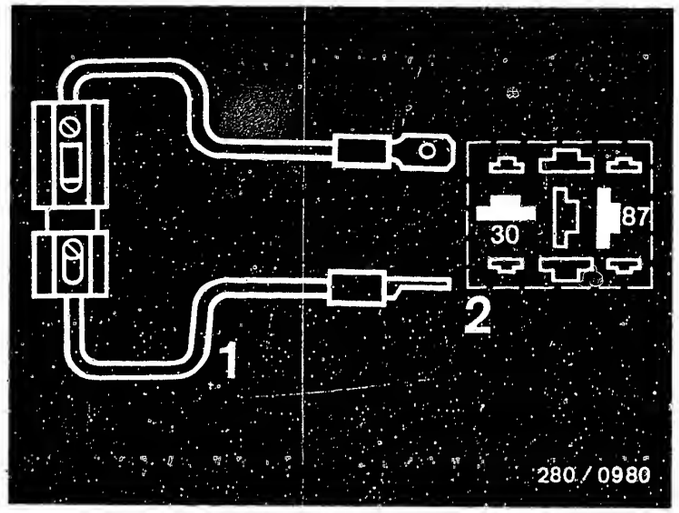
Fuel consumption too high (continued)

yes

Build up the fuel pressure:
Jump the safety circuit.
Caution:
Make sure that no fuel gets onto hot parts of the engine.
Test specification:
Within 60 sec no drop may fall from the mouth of the injection valve. If defective, replace injection valve.

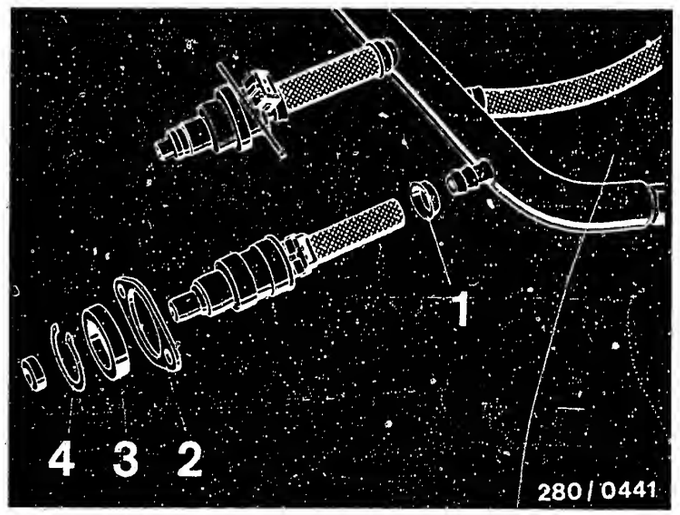
- Removal
- Pull off electrical connection.
- Break open hose-termination sleeve on fuel-distribution pipe.
- Cut open hose in longetudenal direction with a soldering iron and pull off injection valve.
  Caution: Catch any escaping fuel. Do not allow to drip onto hot parts of the engine.
  Warning: Before installing, grease the rubber seals at the valve mouth sleeve only lightly (silicone grease Ft 2 v 1). The other injection-valve parts must remain grease-free.
- Installation
- Plug on hose-termination sleeve (fuel-distribution pipe).
- Plug on injection valve (check for leaks at joints).
  Caution: After testing the injection valves and the fuel-distribution pipes, re-establish the original condition. Check for leaks (unmetered air).

Continued on K13/K14



1=Jumper with fuse holder and 10A fuse (user-fabricated)
2=Top view of pump relay connection base

similar to VW Type 25
1=Hose-termination sleeve
2=Holder
3=Rubber seal
4=Retainer



Fuel consumption too high (continued)

yes

EU version:
Idle speed:
820...920 min^{-1}

CO concentration
(with engine at normal operating temperature):
0.8...1.8 vol.%CO

US version:
Idle speed

800...900 min^{-1}

CO concentration
(with engine at normal operating temperature, lambda sensor connected and DIS connected):

0.3...1.1 vol.%CO

Idle speed and CO concentration correctly adjusted?

yes

Continued on L1/L2

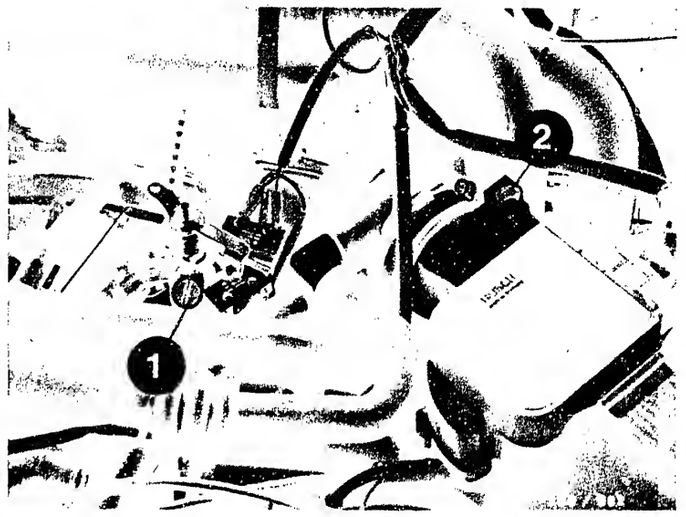
no

Idle speed and CO adjustment
EU version

- Conditions for testing and adjusting
- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not be operating when testing/adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Ignition timing O.K.
- Switch for overrun cutoff/idle closed.
- As of 7.84 model only: disconnect vacuum hose from retard unit of ignition distributor and seal off.
- As of 7.84 model only: disconnect plugs from DIS control unit and plug together.
- Idle-speed stabilization O.K. (with ignition on valve must vibrate and hum).

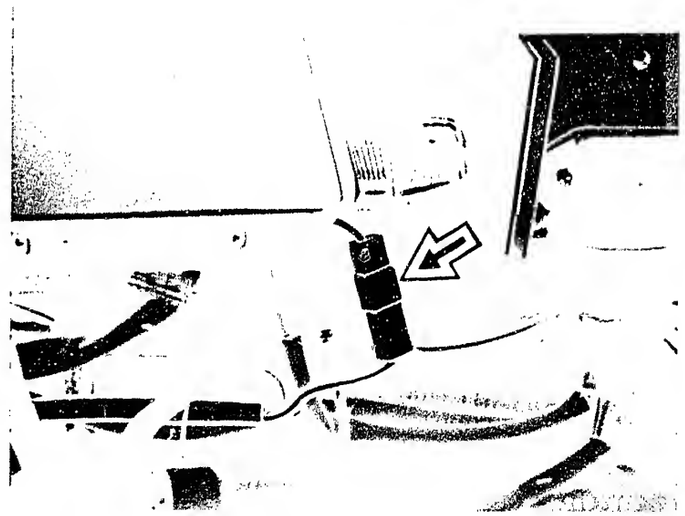
- Test and adjust the idle speed and CO concentration.
- Take apart terminal 1 plug connector (arrow, bottom picture).

Continued on K15/K16



1=Idle-adjusting screw
2=CO adjusting screw

Arrow=Term. 1 plug connector



Fuel consumption too high (continued)

- Test the idle speed and CO concentration and, if necessary, adjust to the set value (average value) by alternately turning the adjusting screws.
  Set values:
  Idle speed 880 min^{-1}
  CO concentration 1.3 vol.%CO

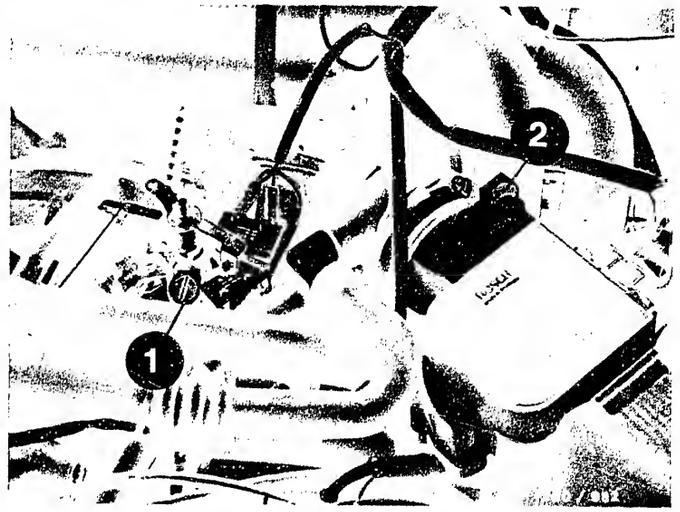
- Plug together the plugs of terminal 1 plug connector.

- After correcting, lock CO adjusting screw with red anti-tamper cap.

  Note:

  After the CO adjustment, the hose for the crankcase ventilation must be re-connected. If the CO concentration now rises, this is not dúe to an incorrect adjustment, but to enriching from the crankcase as a result of oil dilution if the engine is operated predominantly over short distances.

  With lengthy, brisk long-distance trips the fuel content in the oil is reduced and the CO concentration comes back to normal.



1=Idle-adjusting screw
2=CO adjusting screw

yes

Continued on L1/L2

Continued on K17/K18

Fuel consumption too high (continued)

yes

- as of 7.84 model only:

- Ignition timing correctly adjusted. Adjust if necessary.

- With idle stabilization connected and retard hose connected, idle speed and CO concentration must comply with the set values.

If not:
- incorrect DIS control unit
- vacuum unit - retard - or hose connection to vacuum unit defective.

US version

- Conditions for testing and adjusting

- Engine at normal operating temperature

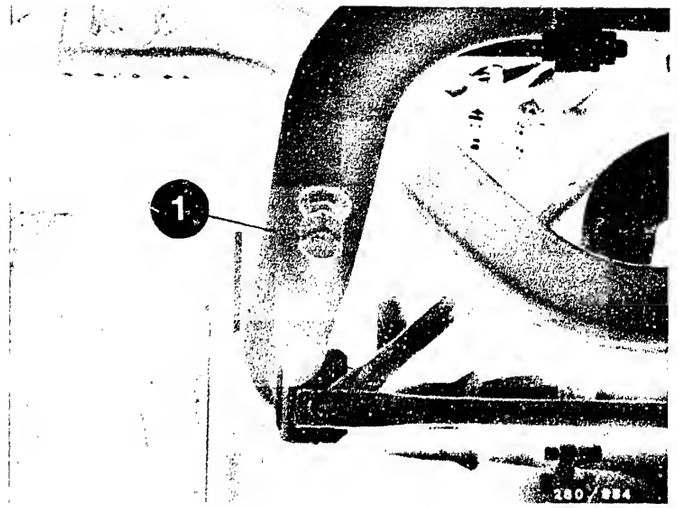
- Electrical devices switched off (radiator fan must not operate when testing/adjusting).

- Hose for crankcase ventilation disconnected from oil breather and plugged tight.

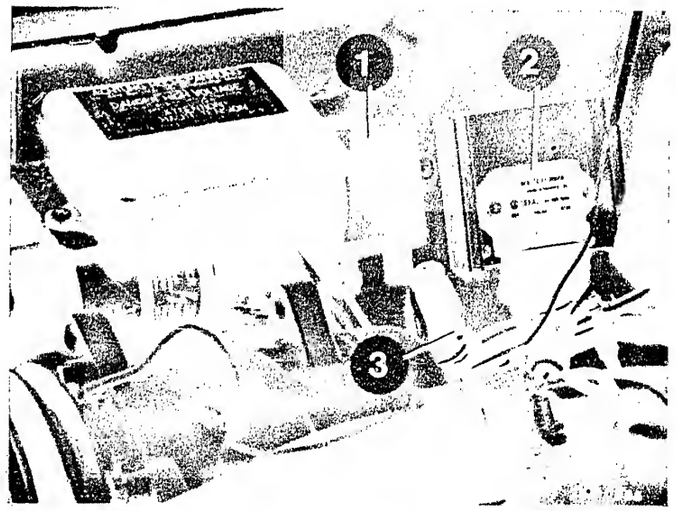
- Switch for overrun cutoff/idle closed.

Continued on L1/L2

Continued on K19/K20



1=Exhaust sampling point



1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected.

Fuel consumption too high (continued)

yes

- Testing and adjusting the idle speed and CO concentration

- Connect testers for ignition timing and engine speed.

- Connect hose of CO tester to the sampling point on the left-hand exhaust pipe by means of screw-type sleeve V.A.G 1506.

- Keep to the sequence of testing/adjusting operations.

- Check the ignition timing and adjust if necessary.

- Disconnect plugs from DIS control unit by pressing on the surfaces on plug/control unit and connect together.

- Start engine and run at idle.

- Check idle speed and adjust if necessary.
  Setting value: 850 min^{-1}

  Check ignition timing and adjust if necessary.

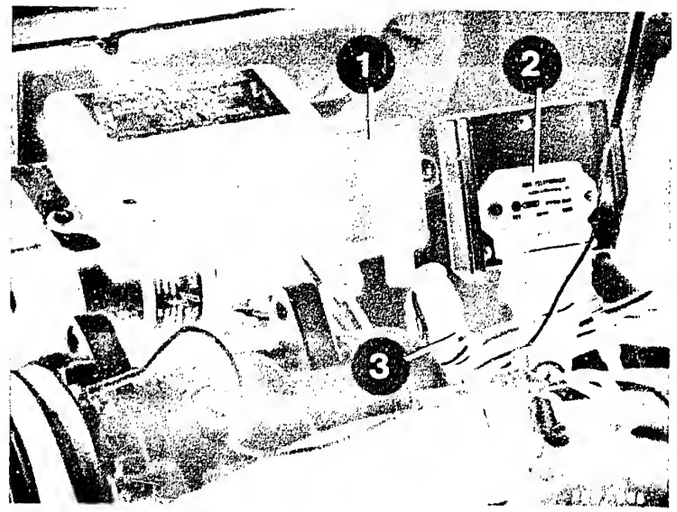
- Let engine idle for approx. 2 min.

- Check engine speed and adjust if necessary.
  Set value: 850 min^{-1}

- Switch off ignition.

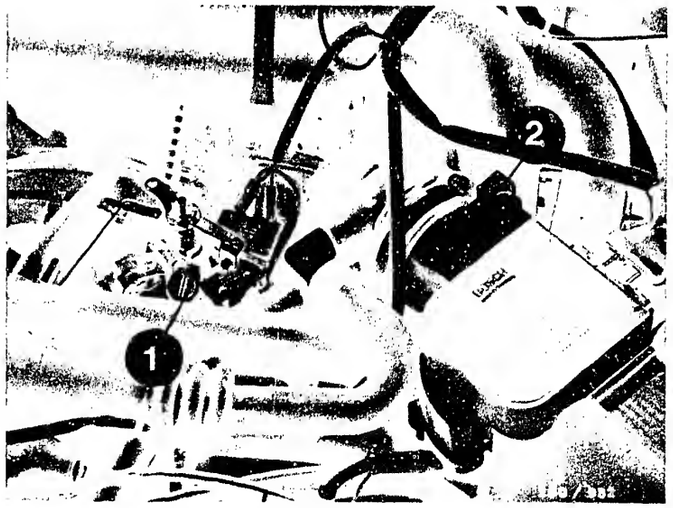
Continued on L1/L2

Continued on K21/K22



1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected.

1=Idle-adjusting screw
2=CO adjusting screw



Fuel consumption too high (continued)

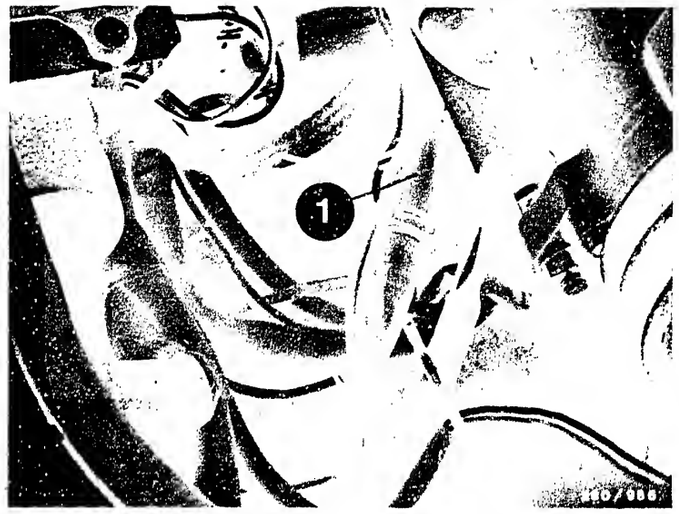
Checking the CO concentration

- Connect plugs on DIS control unit.
- Take apart plug connector for lambda sensor.
- Start engine and check CO concentration.
  Set value: 0.7 vol.%
  adjust if necessary at CO adjusting screw.
- Lock CO adjusting screw with new plug.
- Switch off ignition.
- Plug together connector for lambda sensor.
- Connect hose for crankcase ventilation on oil breather.
- Start engine and briefly raise engine speed (burst of throttle).
- Let engine idle and check idle adjustment:

Idle speed:	850...950 min^{-1}
CO concentration:	0.3...1.1 vol.%

Not within tolerance: replace DIS control unit/ test lambda closed-loop control.

yes



1=Lambda sensor plug connector

Continued on L1/L2

Continued on K23/K24

Fuel consumption too high (continued)

yes

TESTING THE LAMBDA SENSOR AND LAMBDA CLOSED-LOOP CONTROL

- Engine at normal operating temperature

- Connect hose of CO tester to sampling point on left-hand exhaust pipe by means of screw-type sleeve V.A.G. 1506.
- With ignition off, take apart plug connector (1) for lambda sensor.
- Disconnect vacuum hose (2) from pressure regulator and seal off.
- Start engine; CO concentration rise to above 1.5 vol.%.
- Let engine run for at least 2 min.
- Plug together plug connector for lambda sensor. CO concentration must drop to

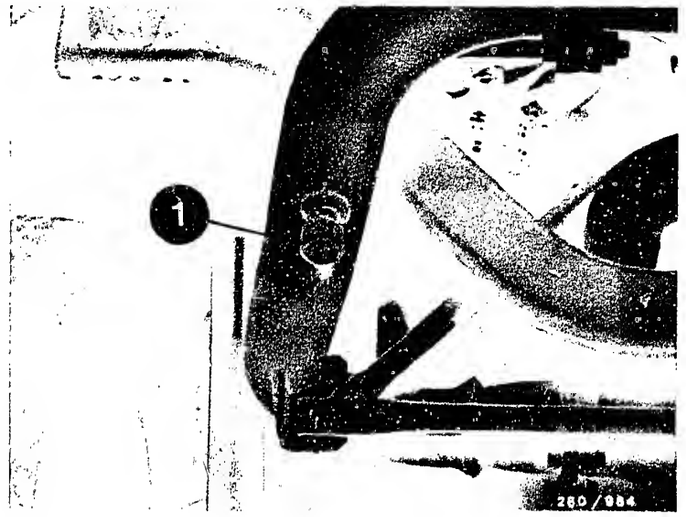
  0.7 ± 0.4 vol.%

If not, the following components may be defective:

- Lead from lambda sensor to control unit or control unit.
  Testing:
  Take apart lambda sensor plug connector and hold lead to control unit against ground.
  CO concentration must rise.
  Connect approx. 2 V to lead.
  CO concentration must drop.
- Lambda sensor (replace).

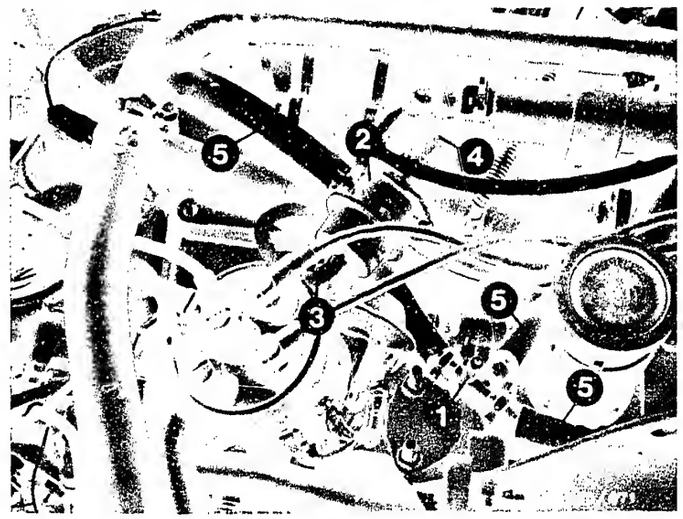
- Exhaust system leaking between catalytic converter and cylinder head (repair leak).

Continued on L1/L2



1=Exhaust sampling point

2=Pressure regulator
3=Vacuum hose to intake manifold



Fuel consumption too high (continued)

yes

For all vehicles:

If CO concentration too high, turn CO adjusting screw in air-flow sensor half a turn in a counter-clockwise direction (hexagon-socket-head cap screw AF 5 mm).

Check idle speed and CO concentration again. If necessary, make corrections in several steps. After adjusting, use new red plug (1 280 508 012).

Air-flow sensor mechanically O.K.?

no

Testing:

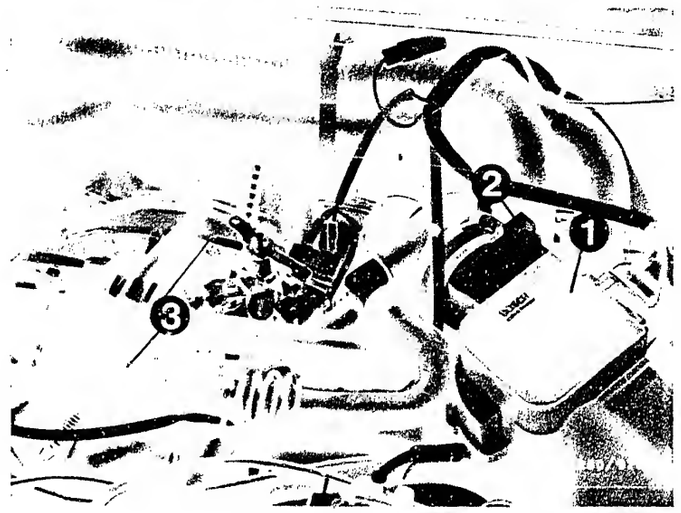
Loosen clamp-type fasteners on air filter. Lift off top part of air filter.

- Check air-flow sensor flap for freedom of movement

Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it it being opened.

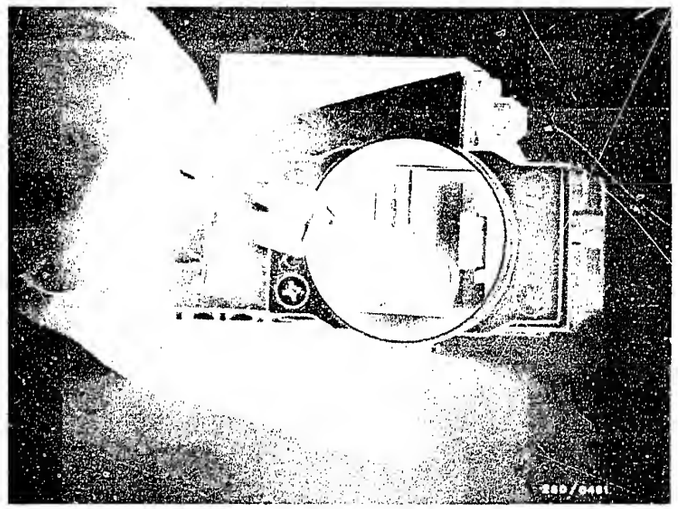
yes

Continued on L3/L4



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Fuel consumption too high (continued)

- Mechanical examination of air-flow sensor

  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

  The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.

  Caution: After testing is completed, the air filter and the air-flow sensor must be re-assembled.

Trouble-shooting program completed for customer complaint

"Fuel consumption too high".

Fault eliminated?

no →

Further possibilities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).

- Engine not mechanically O.K. (compression, valve setting, valve timing, worn camshaft).

MAXIMUM ENGINE POWER/TOP SPEED NOT REACHED

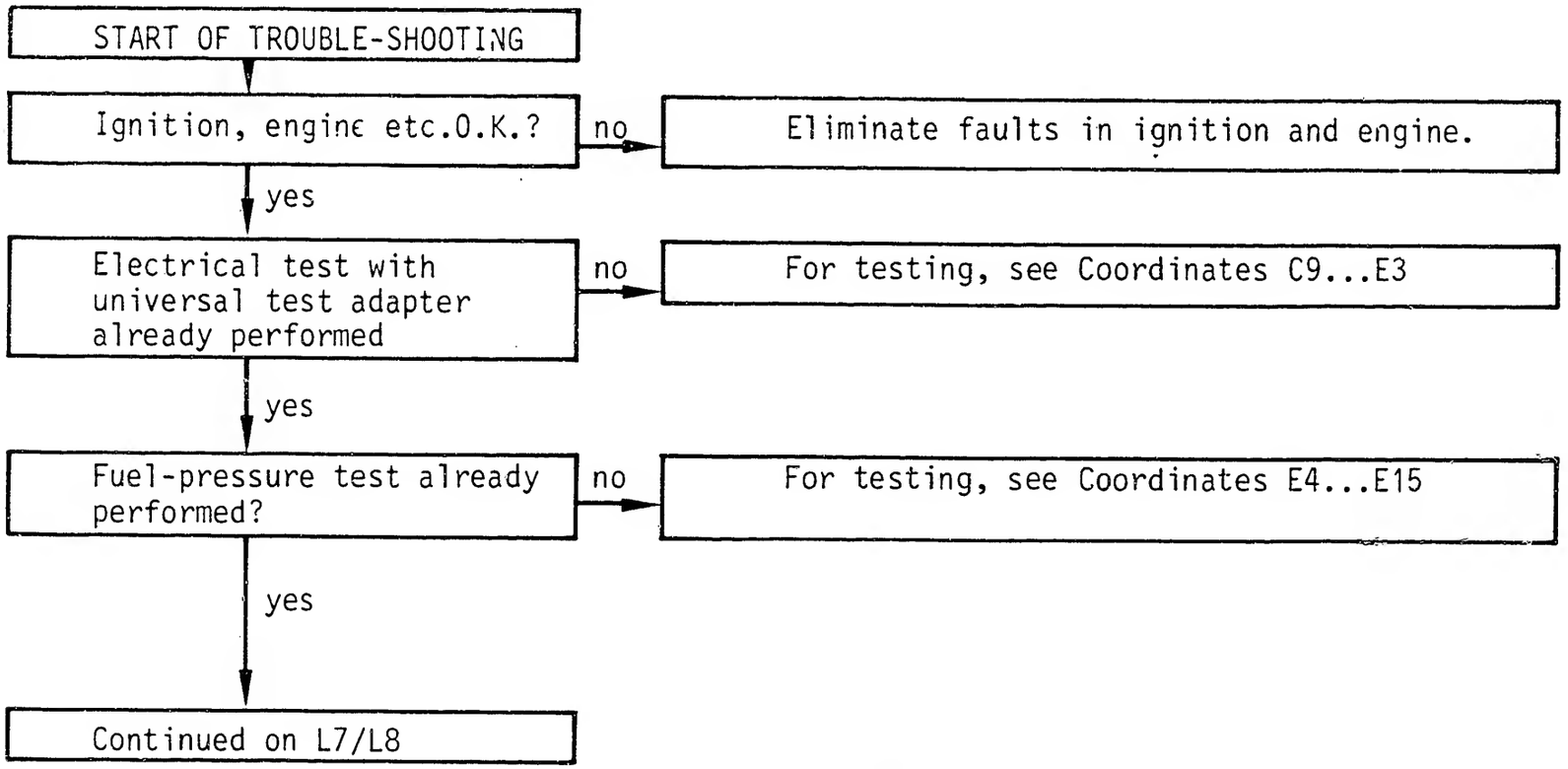
Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.



Maximum engine power/top speed not reached (continued)

yes

Is throttle valve opening fully?
- Accelerator, throttle linkage, throttle cable O.K.?

no →
- Throttle linkage may stick due to floor mat.
- If throttle cable kinked - replace.

yes

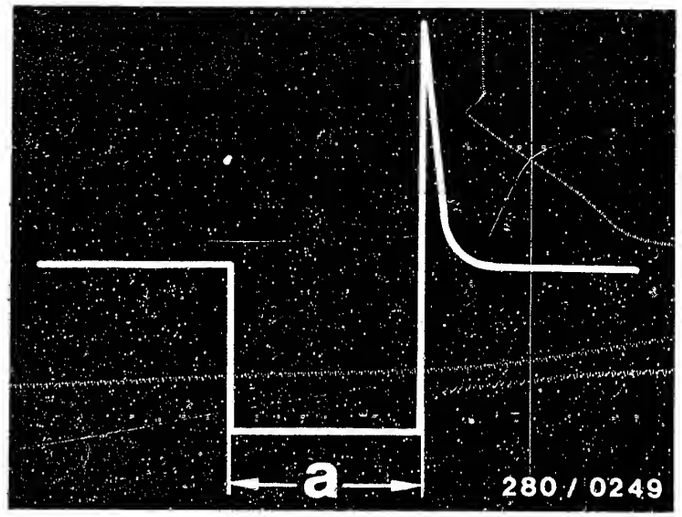
Full-load switch O.K.?
- Does the injection-pulse length change at idle (full-load enrichment)?

no →

Connect test lead as follows:
One terminal of the test lead is connected between an injection valve and its connecting leads. Of the other two terminals, only one terminal need be connected to the special input of the motortester.
Caution:
The other terminal must not come into contact with vehicle ground.
- If correctly connected, the image shown opposite is visible on the oscilloscope. Using the test lead it is possible to test the injection pulses at the injection valves with the engine running.
- Test the full-load enrichment.
Observe the injection pulses in the part-load range. Disconnect full-load switch plug and ground term. 4.
Caution:
- Do not bend any terminals. Injection pulse must become longer. If not, check connecting leads from control-unit plug to full-load switch (term. 4 and ground) for continuity. If O.K., replace control unit.
Caution: After testing, re-establish the original condition.

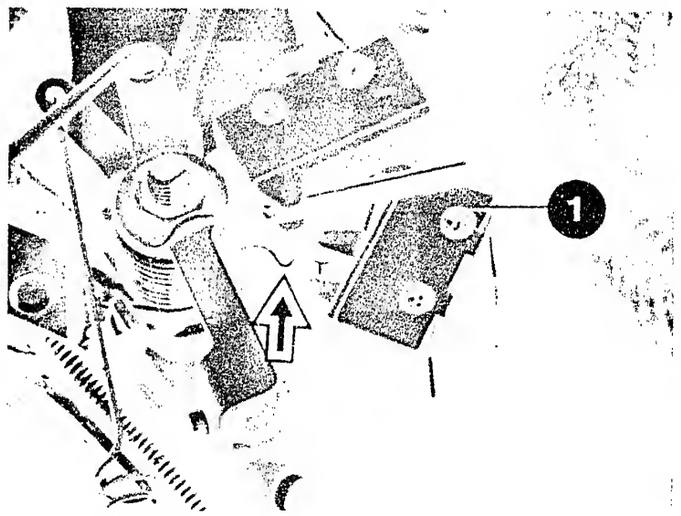
yes

Continued on L9/L10



Injection pulse of a switched output stage (measured at the injection valve)
a=Pulse length (dependent on engine load)

1=Full-load switch



Maximum engine power/top speed not reached (continued)

yes

Fuel delivery of electric fuel pump O.K.?

Test specification:
min. 550 cm³/30 s

no

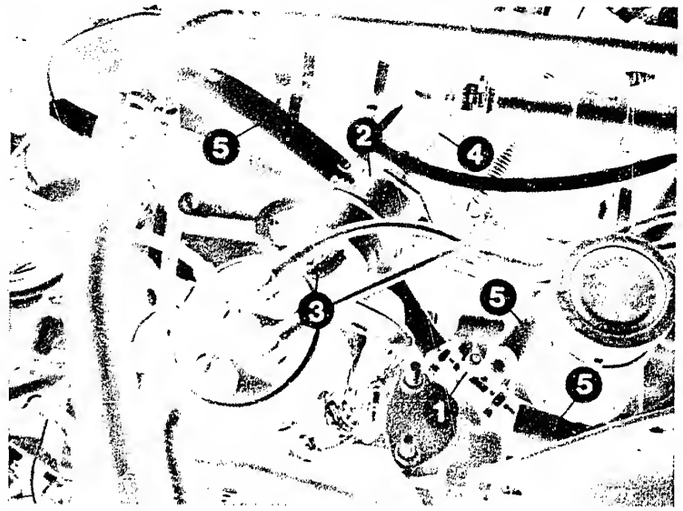
- Measuring the fuel delivery:

  For testing, disconnect joint between fuel return connection (on pressure regulator) and fuel return line (to fuel tank).
  Connect hose and lead into a 5 l vessel with graduated scale. Disconnect pump relay. Insert jumper between term. 87 and term. 30 in the connection base. Electric fuel pump must operate.
  Test specification:
  min.: 550 cm³/30 s

  Caution:
  Jumper must be removed again after testing is completed.
  Remedy if test specification not reached:

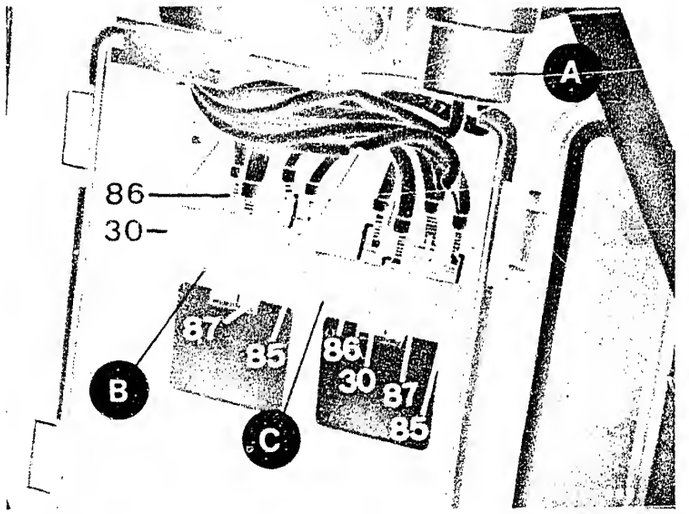
- Fuel filter clogged - replace.
- Voltage at connection terminals of electric fuel pump with engine running: min. 12 V. If not, clean contacts. If necessary, eliminate poor ground connection. Replace leads.
- Pressure regulator defective - replace.
- If fuel delivery too low, replace electric fuel pump.

  Testing completed: Remove jumper from connection base and connect pump relay. Re-connect fuel lines.



2=Pressure regulator
4=Fuel return line

C=Pump relay



Continued on L11/L12

Maximum engine power/top speed not reached (continued)

yes

Air-flow sensor mechanically O.K.? — no

Testing:
Loosen clamp-type fasteners on air filter.
Lift off top part of air filter.

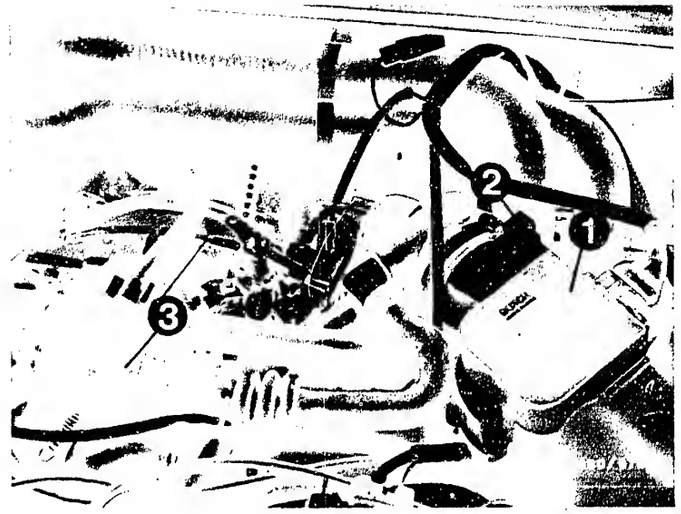
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.

- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
Caution: After testing is completed, the air filter and the air-flow sensor must be re-assembled.

yes

Continued on L13/L14



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap

Maximum engine power/top speed not reached (continued)

yes

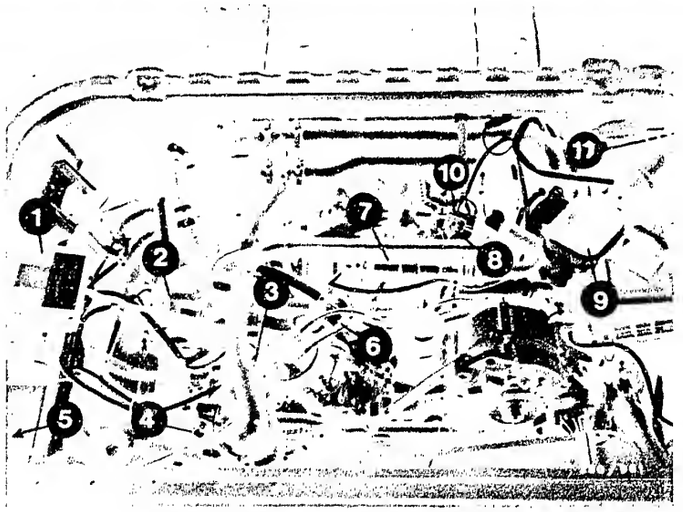
Are all hose lines and electrical lead connections correctly connected, not kinked or damaged?
Visual examination.
Air-intake system check for leaks with 0.3 bar gauge pressure?

no

- Check whether hoses of air-intake system and of fuel line system are correctly connected, not kinked or damaged. If necessary, replace hoses. Eliminate leaks by new seals or by re-tightening the connecting screws.
- Leak test:
  Seal off the exhaust tail pipe. Loosen clamp-type fastene-s on air filter. Lift off top part of air filter and seal off air-flow sensor duct. Disconnect hose after idle actuator (EU version) or auxiliary-air device (US version) and blow air (0.3 bar gauge pressure) into the intake manifold with a compressed-air gun. Seal off connection port on idle actuator/auxiliary-air device. Fully open throttle valve. Brush or spray all joints with soapy water. Leaks may also occur at the following points on the engine: oil dipstick not securely inserted, defective cap seal on oil filler neck etc. Bubbling or foaming indicates a leak.

yes

Continued on L15/L16



EU version (US version similar)
1 =Main and pump relays
2 =Injection valves
3 =Central ground
4 =Temperature sensor II
5 =Control unit
6 =Pressure regulator
7 =Idle actuator
8 =Full-load switch
9 =Air-flow sensor
10=Idle switch
11=Idle controller
(Behind a cover)

Maximum engine power/top speed not reached (continued)

yes

Trouble-shooting program completed for customer complaint

"Maximum engine power/top speed not reached".

Fault eliminated?

no

Further possiblities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).

- Engine not mechanically O.K. (compression, valve setting, valve timing, worn camshaft).

IDLE SPEED AND CO CONCENTRATION TOO LOW OR TOO HIGH

Trouble-shooting program according to customer complaints

Procedure

The test is divided into 3 rows of boxes:

- The left-hand row contains the questions on the tests.
- The center row contains descriptions of the testing and adjusting operations on components.
- The right-hand row shows the illustrations belonging to the text and explains the illustrations.

If the questions can be answered conclusively with "yes" without testing, proceed to the next question down.
If, on the other hand, the answer to the question is "no" and you suspect a fault, branch to the center row of boxes and carry out the tests given there. After testing, continue trouble-shooting at the point at which you branched off.

START OF TROUBLE-SHOOTING

Ignition, engine etc. O.K.? — no → Eliminate faults in ignition and engine.

yes

Electrical test with universal test adapter already performed? — no → For testing, see Coordinates C9...E3

yes

Fuel-pressure test already performed? — no → For testing, see Coordinates E4...E15

yes

Continued on L19/L20

Idle speed and CO concentration too low or too high (continued)

yes

EU version:
Idle speed:
820...920 min^{-1}

CO concentration
(with engine at normal operating temperature):
0.8...1.8 vol.%CO

US version:
Idle speed

800...900 min^{-1}

CO concentration
(with engine at normal operating temperature, lambda sensor connected and DIS connected):

0.3...1.1 vol.%CO

Idle speed and CO concentration correctly adjusted?

yes

Continued on M7/M8

no

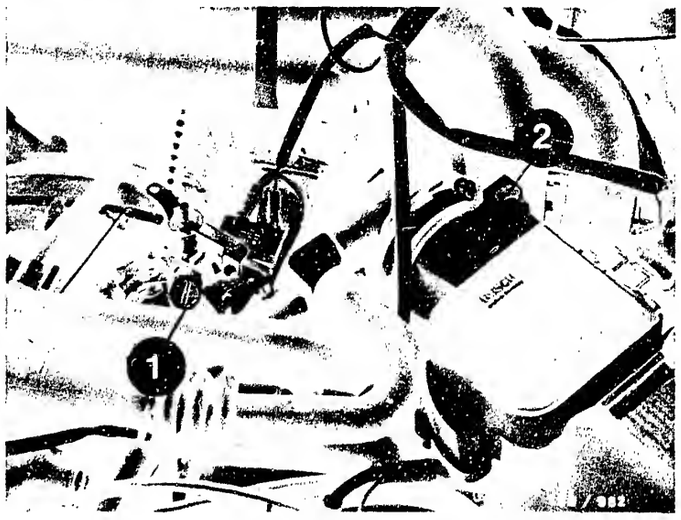
Idle speed and CO adjustment
EU version

- Conditions for testing and adjusting
- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not be operating when testing/adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Ignition timing O.K.
- Switch for overrun cutoff/idle closed.
- As of 7.84 model only: disconnect vacuum hose from retard unit of ignition distributor and seal off.
- As of 7.84 model only: disconnect plugs from DIS control unit and plug together.
- Idle-speed stabilization O.K.
(with ignition on valve must vibrate and hum).

- Test and adjust the idle speed and CO concentration.
- Take apart terminal 1 plug connector (arrow, bottom picture).
- Test the idle speed and CO concentration and, if necessary, adjust to the set value (average value) by alternately turning the adjusting screws.
Set values:

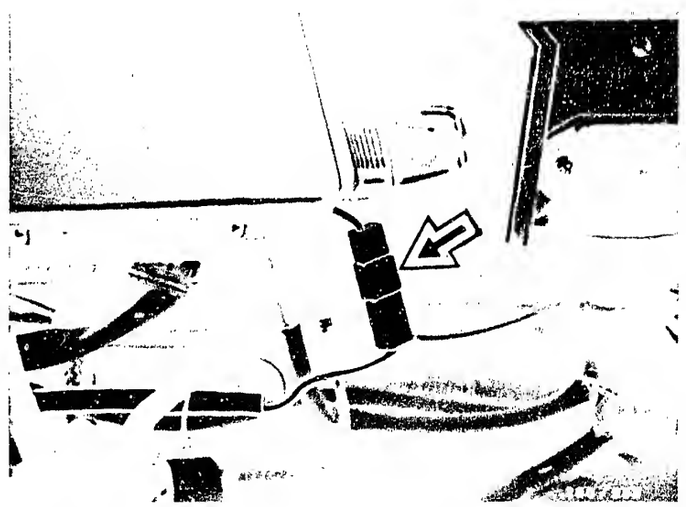
Idle speed	880 min^{-1}
CO concentration	1.3 vol.%CO

Continued on L21/L22



1=Idle-adjusting screw
2=CO adjusting screw

Arrow=Term. 1 plug connector

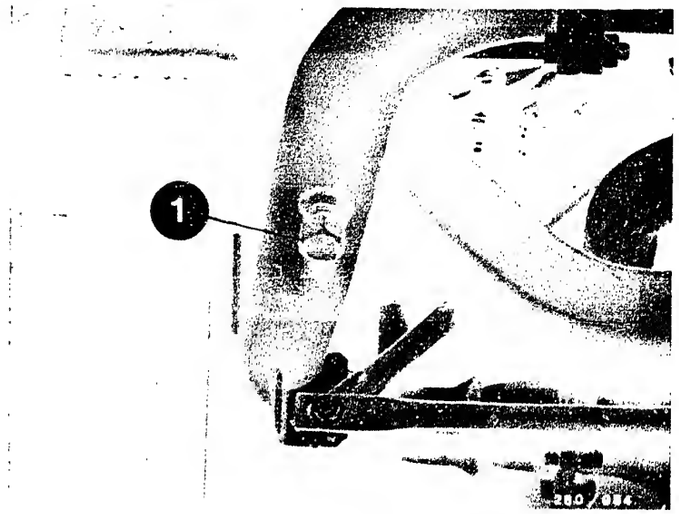


Idle speed and CO concentration too low or too high (continued)

- Plug together the plugs of terminal 1 plug connector.
- After correcting, lock CO adjusting screw with red anti-tamper cap.

Note:
After the CO adjustment, the hose for the crankcase ventilation must be re-connected. If the CO concentration now rises, this is not due to an incorrect adjustment, but to enriching from the crankcase as a result of oil dilution if the engine is operated predominantly over short distances.

With lengthy, brisk long-distance trips the fuel content in the oil is reduced and the CO concentration comes back to normal.



1=Exhaust sampling point

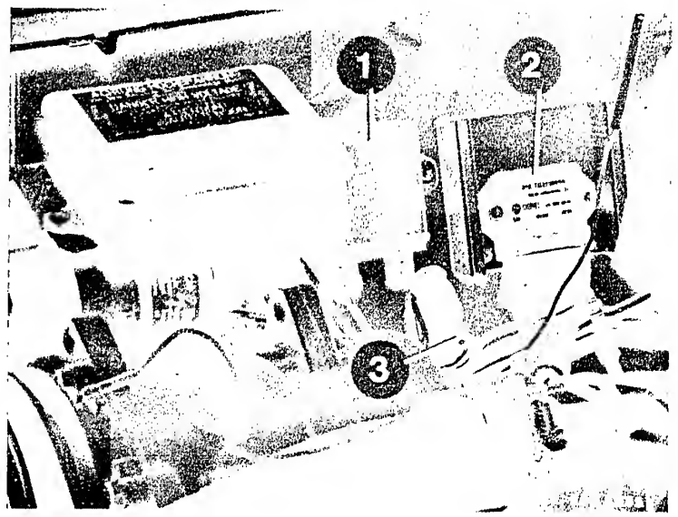
yes

- as of 7.84 model only:

- Ignition timing correctly adjusted, adjust if necessary.
- With idle stabilization connected and retard hose connected, idle speed and CO concentration must comply with the set values.

If not:
- incorrect DIS control unit
- vacuum unit - retard - or hose connection to vacuum unit defective.

1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected



Continued on M7/M8

Continued on L23/L24

Idle speed and CO concentration too low or too high (continued)

US version

- Conditions for testing and adjusting

- Engine at normal operating temperature
- Electrical devices switched off (radiator fan must not operate when testing/adjusting).
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Switch for overrun cutoff/idle closed.

- Testing and adjusting the idle speed and CO concentration

- Connect testers for ignition timing and engine speed.
- Connect hose of CO tester to the sampling point on the left-hand exhaust pipe by means of screw-type sleeve V.A.G 1506.

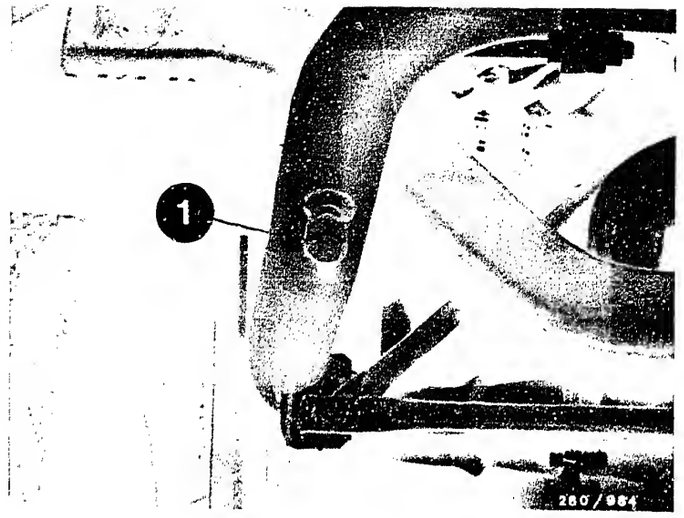
- Keep to the sequence of testing/adjusting operations

- Check the ignition timing and adjust if necessary.
- Disconnect plugs from DIS control unit by pressing on the surfaces on plug/control unit and connect together (3) (bottom picture).
- Start engine and run at idle.
- Check idle speed and adjust if necessary.
  Setting value: 850 min^{-1}.

yes

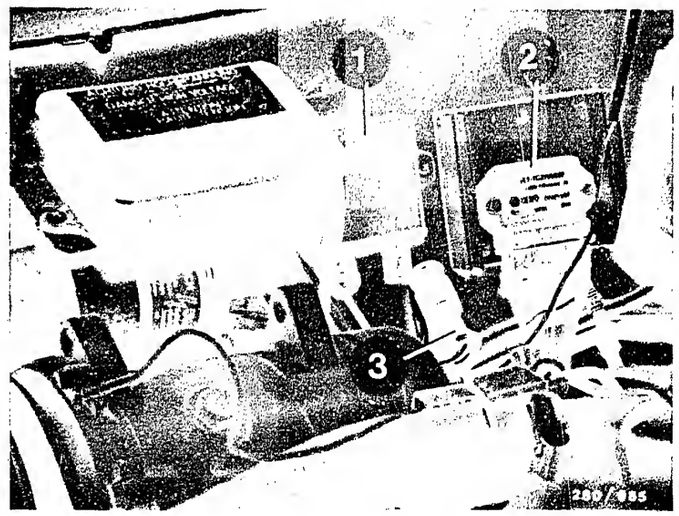
Continued on M7/M8

Continued on M1/M2



1=Exhaust sampling point

1=Digital idle stabilization control unit (DIS)
2=TI trigger box
3=Plugs (DIS) connected



Idle speed and CO concentration too low or too high (continued)

yes

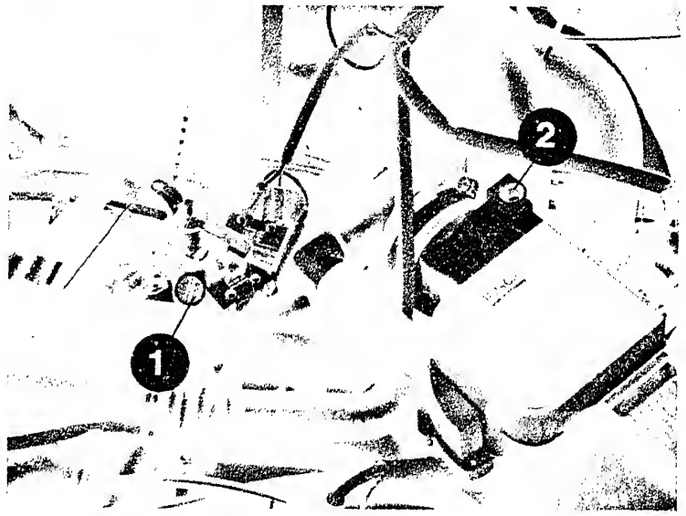
- Check ignition timing and adjust if necessary.
- Let engine idle for approx. 2 min.
- Check engine speed and adjust if necessary.
  Set value: 850 min^{-1}
- Switch off ignition.

Checking the CO concentration

- Connect plugs on DIS control unit.
- Take apart plug connector for lambda sensor.
- Start engine and check CO concentration.
  Set value: 0.7 vol.%
  adjust if necessary at CO adjusting screw.
- Lock CO adjusting screw with new plug.
- Switch off ignition.
- Plug together connector for lambda sensor.
- Connect hose for crankcase ventilation on oil breather.

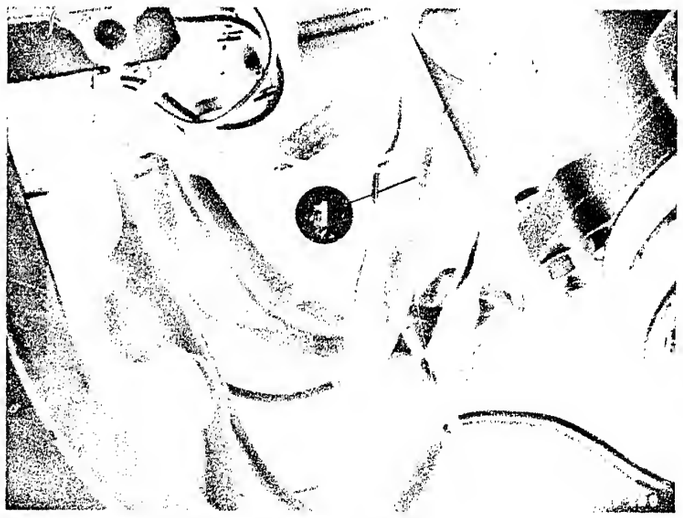
Continued on M7/M8

Continued on M3/M4



1=Idle-adjusting screw
2=CO adjusting screw

1=Lambda sensor plug connector



Idle speed and CO concentration too low or too high (continued)

- Start engine and briefly raise engine speed (burst of throttle).
- Let engine idle and check idle adjustment:

  Idle speed: 850...950 min^{-1}
  CO concentration: 0.3...1.1 vol.%

  Not within tolerance: replace DIS control unit/test lambda closed-loop control.

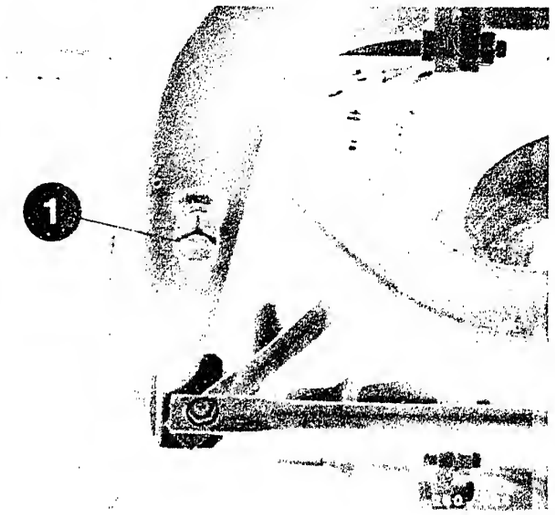
TESTING THE LAMBDA SENSOR AND LAMBDA CLOSED-LOOP CONTROL

- Engine at normal operating temperature
  Connect hose of CO tester to sampling point on left-hand exhaust pipe by means of screw-type sleeve V.A.G. 1506.
- With ignition off, take apart plug connector (1) for lambda sensor.
- Disconnect vacuum hose (2) from pressure regulator and seal off.
- Start engine; CO concentration rises to above 1.5 vol.%.
- Let engine run for at least 2 min.
- Plug together plug connector for lambda sensor.
  CO concentration must drop to
  0.7 ± 0.4 vol.%.

yes

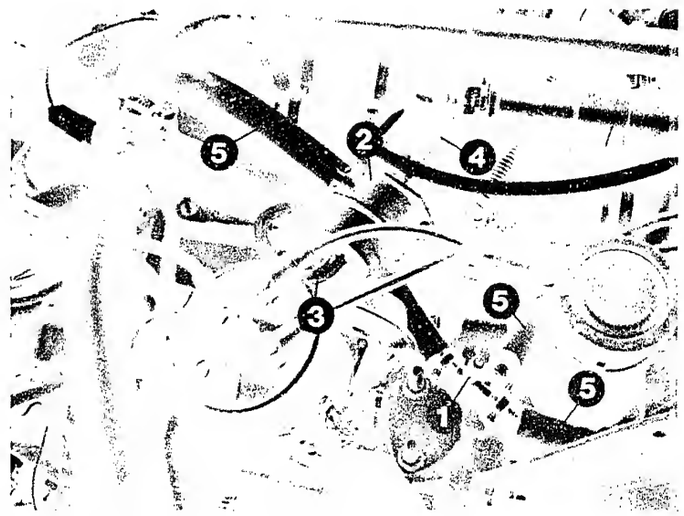
Continued on M7/M8

Continued on M5/M6



1=Exhaust sampling point

2=Pressure regulator
3=Vacuum hose to intake manifold



Idle speed and CO concentration too low or too high (continued)

If not, the following components may be defective:

- Lead from lambda sensor to control unit or control unit.
  Testing:
  Take apart lambda sensor plug connector and hold lead to control unit against ground.

  CO concentration must rise.

  Connect approx. 2 V to lead.

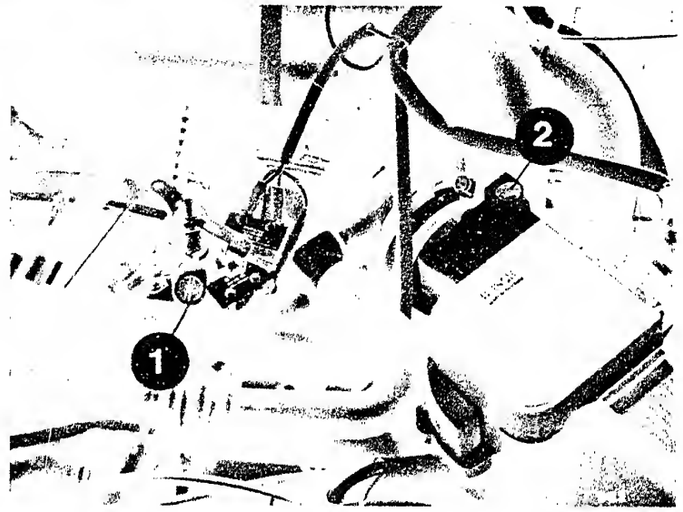
  CO concentration must drop.
- Lambda sensor (replace).
- Exhaust system leaking between catalytic converter and cylinder head (repair leak).

yes

For all vehicles:

If CO concentration too high, turn CO adjusting screw in air-flow sensor half a turn in a counter-clockwise direction (hexagon-socket-head cap screw AF 5 mm). Check idle speed and CO concentration again. If necessary, make corrections in several steps. After adjusting, use new red plug (1 280 508 012).

Continued on M 7/M 8



1=Idle-adjusting screw
2=CO adjusting screw

Idle speed and CO-concentration too low or too high (continued)

yes

On US version only
Auxiliary-air device mechanically O.K.?
Free cross-section?
- cold - open?
- warm - closed?
- Engine-speed drop when hose pinched off? (engine cold).

no →

Testing:
- Visual examination of auxiliary-air device
Disconnect hoses and look down (possibly using a small mirror). When cold, the cross-section must be partially open; when the engine is warm it must be closed. If not, replace auxiliary-air device.

- Functional test of auxiliary-air device:
With engine cold, pinch off hose to auxiliary-air device. Engine speed must drop. With the engine warm, pinch off hose to auxiliary-air device. Engine speed must not drop noticeably. If not, replace auxiliary-air device (pay attention to the direction of flow).

yes

On US version only
Electrical operation of auxiliary-air device (power supply, ground lead, resistance) O.K.?

no →

Start engine.
- Voltage at plug min. 12 V. If not, check the following leads for continuity (set value approx. 0Ω):
- From term. 33 to central ground.
- From term. 34 to pump relay term. 87.
- Resistance of auxiliary-air device 20 ... 55 Ω (plug disconnected).

If the resistance is not within tolerance, replace the auxiliary-air device.

yes

Continued on M9/M10

Arrow=Auxiliary-air device

Idle speed and CO concentration too low or too high (continued)

Idle stabilization O.K.? (non-Bosch)
- Test (operation)
- Electrical connections
- Test (control)

O.K.?

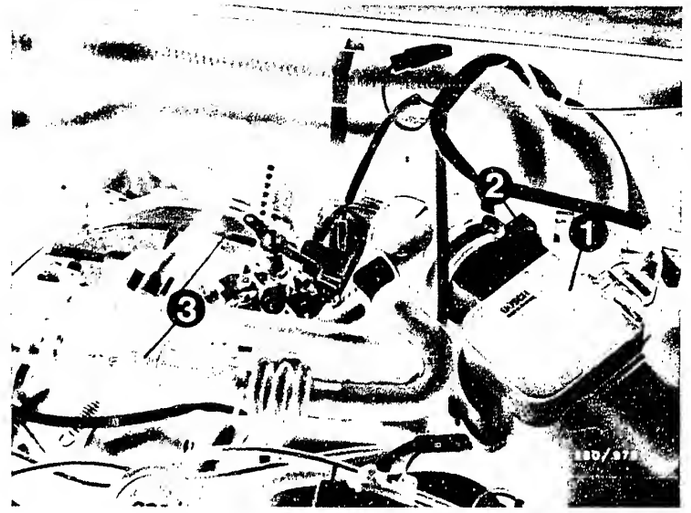
no

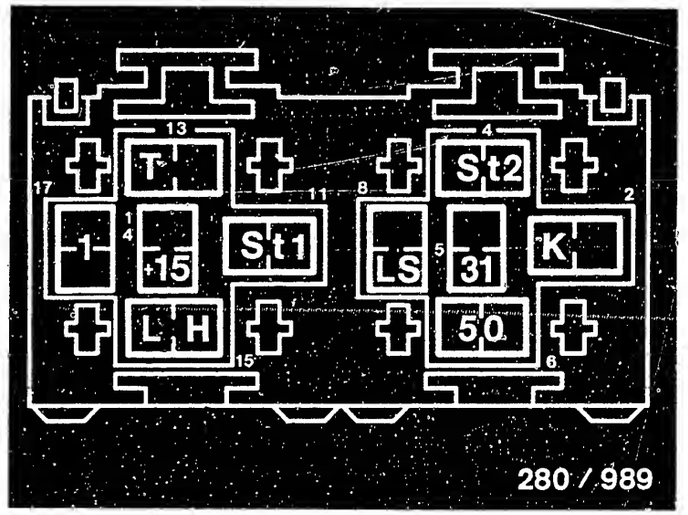
- Test (Operation)
- Switch on ignition.
- Idle actuator (3) for idle stabilization must vibrate and hum. If O.K., continue with test (control).
- If not, disconnect plug from idle actuator (3) and measure the resistance of the idle actuator with multimeter. Set value: approx. 10 Ω
- If set value not O.K., replace idle actuator (3).
- If set value O.K., connect plug on idle actuator (3) and test electrical connections at idle controller (1).
- Test electrical connections at idle controller (1) (center photo): (multimeter) Disconnect L2 control unit and idle stabilization control unit.
- between term. 31 and term. +15, ignition "ON" - 8 ... 15 V
- between term. 31 and term. LH, ignition "ON" and jump leads on pressure switch (near air filter) - 8... 15 V. After measuring, remove jumper and connect plug.
- between term. 31 and term. 50, selector lever at P or N (on vehicles with automatic transmission only). Operate starting motor - min. 8V
- between term. 31 and term. T, at ambient temperature (+15°C...+30°C) - 1.45...3.3 kΩ; engine at normal operating temperature (approx. +80°C) - 280...360Ω.
- between term. 31 and term. LS, idle switch closed - approx. 0 Ω

yes

Continued on M13/M14

Continued on M11/M12





Idle speed and CO concentration too low or too high (continued)

yes

- between term. St1 and term. St2 - approx. 10 Ω
- between term. 1 and ignition coil term. 1 - approx. 0 Ω
- between term. K and on compressor (if applicable) - approx. 0 Ω.

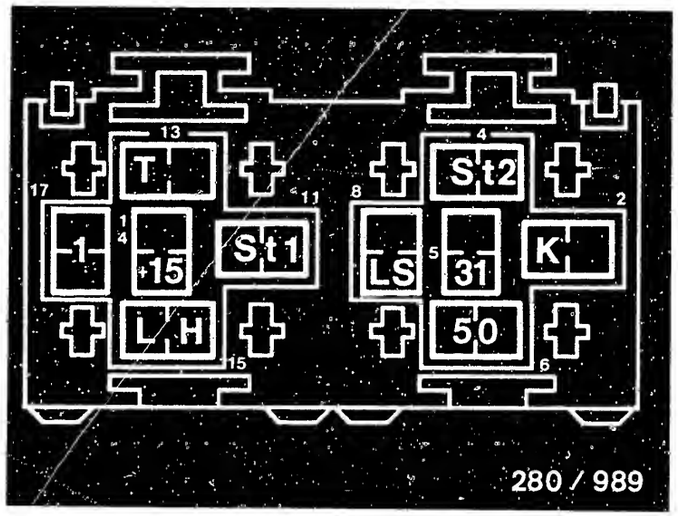
If set values are obtained - replace control unit for idle stabilization.
Re-connect both control units.

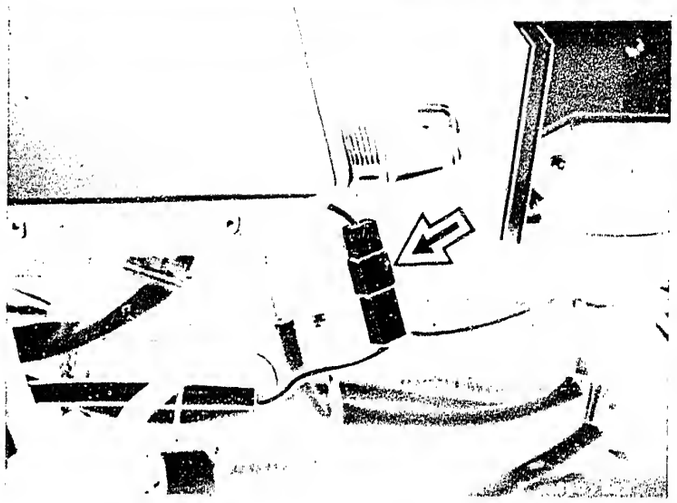
Test (control)
Conditions for testing

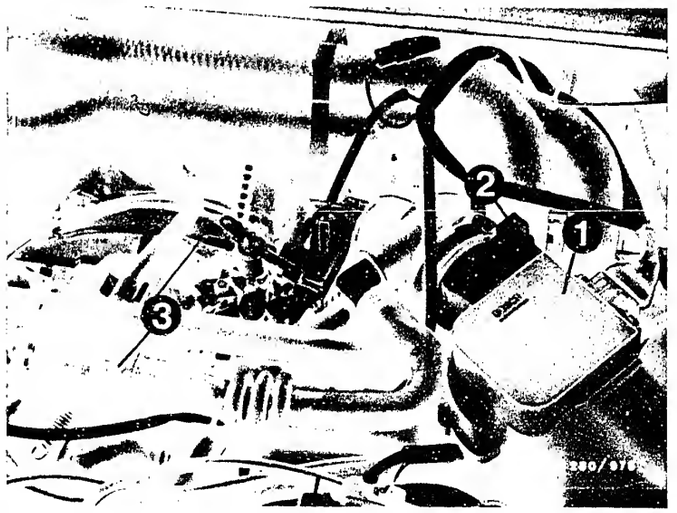
- Engine oil temperature min. +60°C.
- Electrical devices switched off.
- Air-intake leak-tight
- Ignition timing O.K.
- Idle speed O.K.
- CO concentration O.K.
- Hose for crankcase ventilation disconnected from oil breather and plugged tight.
- Connect multimeter (current measurement) to idle actuator (3) for idle stabilization.
- Let engine idle.
  Set value:
  approx. 430 ± 20 mA fluctuating
- Take apart plug connector for terminal 1 (arrow - center photo)
  Set value:
  approx. 430 mA constant

If test conditions observed and set values not O.K., replace control unit for idle stabilization.

Continued on M13/M14







Idle speed and CO concentration too low or too high (continued)

yes

Air-flow sensor mechanically O.K.?

no

Testing:
Loosen clamp-type fasteners on air filter.
Lift off top part of air filter.

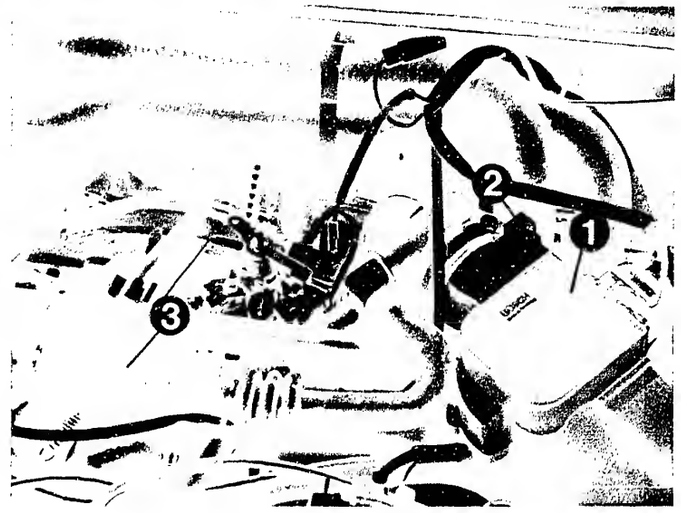
- Check air-flow sensor flap for freedom of movement
  Open air-flow sensor flap by hand. It must be possible to move the sensor flap with uniform ease from its fully closed position to its fully open position. When released, the flap must completely close again by itself. The sensor flap must not catch when it is being opened.

- Mechanical examination of air-flow sensor
  Watch for signs of abrasion and rubbing. Clean air-flow sensor if it is very dirty inside and rub out with a lint-free cloth. If there are signs of abrasion or rubbing, replace the air-flow sensor.

The sensor flap must return to its rest position. If not, the stopper or the sensor flap is bent. Replace the air-flow sensor.
Caution: After testing is completed, the air filter and the air-flow sensor must be re-assembled.

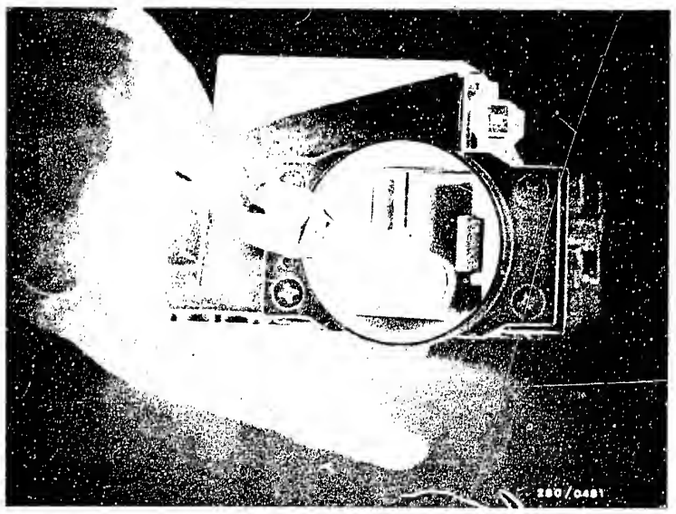
yes

Continued on M15/M16



1=Air-flow sensor
2=CO adjusting screw

Opening the air-flow sensor flap



Idle speed and CO concentration too low or too high (continued)

yes

EU version

CO measured value below test specification 1.8 vol.%CO ? (US version below test specification: 1.1 vol.%CO?)

no

Cold-start control O.K.? (control unit function)

- Take out pump fuse (No. 1)
- Connect test lead between an injection valve.
- Disconnect plug from engine temperature sensor II (double NTC). Color of plug blue
- Connect motortester/multimeter to test lead. (V setting, measuring range 10 V).

yes

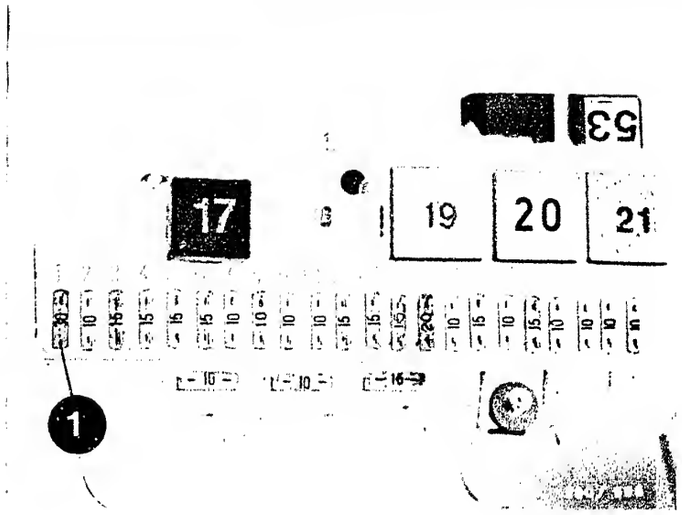
Continued on M17/M18

Functional test:

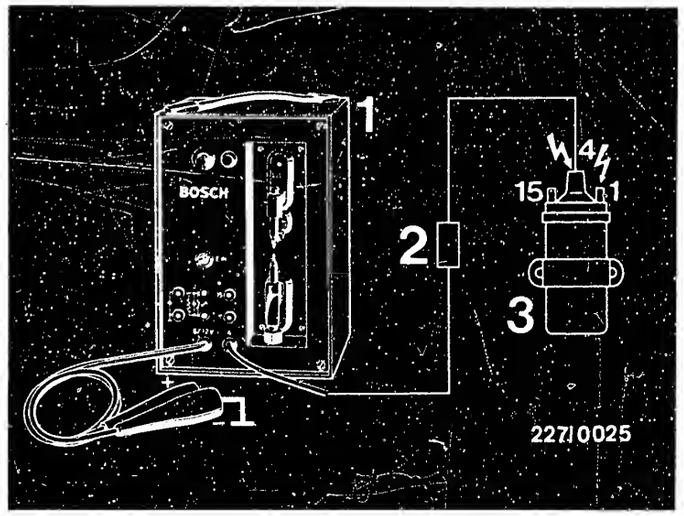
- Remove pump fuse.
- Disconnect ignition cable term. 4 from ignition distributor cap and connect to vehicle ground with spark gap. (Caution! Engine must not start).

Caution:
When using a spark gap - in order to prevent irreparable damage to the trigger box - an interference-suppression resistor of at least 2 kΩ must be connected between spark gap and ignition coil term. 4, e.g. sleeve-type suppressor (5 kΩ) 0 356 500 001.

Continued on M17/M18



1=Pump fuse



1=Spark gap
2=5 kΩ sleeve-type suppressor
3=Ignition coil
=dangerous voltages (400 V - 25 kV)

Idle speed and CO concentration too low or too high (continued)

yes

- Disconnect ignition cable term. 4 from ignition distributor and connect to ground by way of a spark gap. Start engine.
  Voltage at injection valve must drop during starting from approx. 5 V to approx. 0.5 V (with engine at normal operating temperature or with NTC II plug connected the voltage is less than 0.5 V).
  After testing, re-establish the original condition.

yes

Continued on M21/M22

- Connect test lead 1 684 463 093.

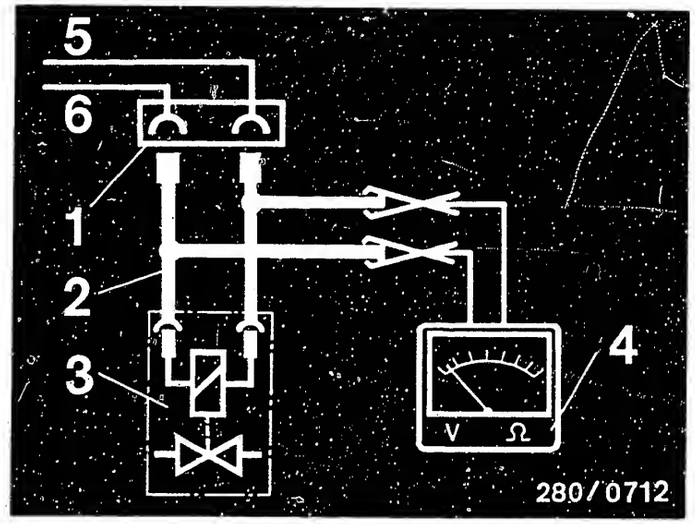
  Connect 2-pole test lead 1 684 463 093 between an injection valve and its electrical connecting lead.

- Disconnect plug from temperature sensor II (engine).
  (Double NTC, color of plug blue)
  Engine must not start when starting motor is operated.

- Measuring:
- Start engine
- Voltage reading drops from initially approx. 5 V within approx. 15 sec cranking time to approx. 0.5 V.
  If voltage values not reached, replace control unit.
- Wait approx. 1 minute before repeating voltage test.
- Connect plug on temperature sensor. If engine at normal operating temperature, start.
  Voltage reading less than 0.5 V.
  If not, replace temperature sensor II (double NTC).

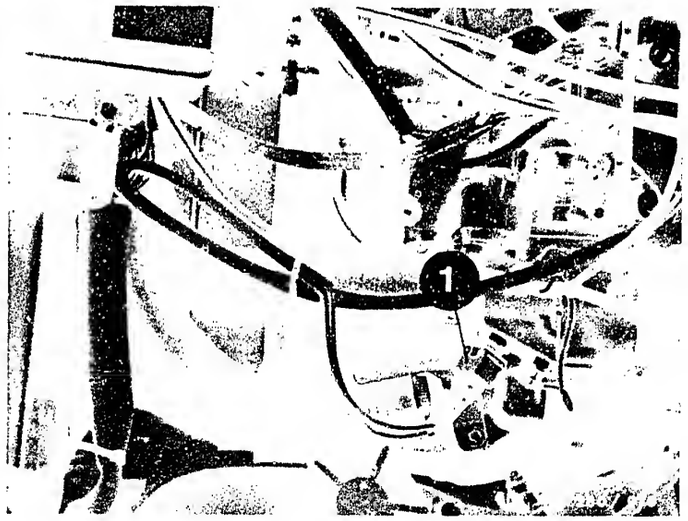
  Caution:
  Re-establish the original condition after testing.

Continued on M19/M20



1=Connector of injection valve lead
2=Test lead 1 684 463 093
3=Injection valve
4=Multimeter/motortester
5=from pump relay term. 87
6=from control relay term. 11
or 12 or 23 or 24

1=Temperature sensor II (engine)
(blue plug)



Idle speed and CO concentration too low or too high (continued)

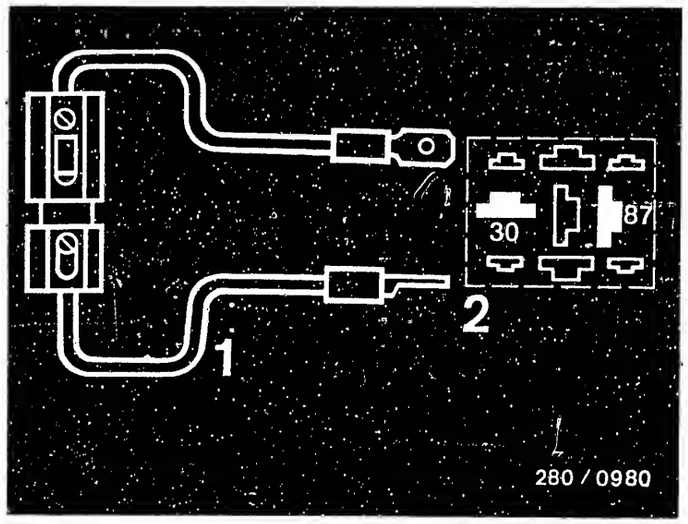
yes

- Leak test on solenoid-operated injection valves
- Remove fuel-distribution pipes (left and right) with injection valves:
  Remove injection valves in pairs. Pull the two injection valves simultaneously and carefully out of the cylinder head. Fuel lines remain connected.
  Build up the fuel pressure:
  Jump the safety circuit.
  Caution:
  Make sure that no fuel gets onto hot parts of the engine.
  Test specification:
  Within 60 sec no drop may fall from the mouth of the injection valve. If defective, replace injection valve.
- Removal
- Pull off electrical connection.
- Break open hose-termination sleeve on fuel-distribution pipe.
- Cut open hose in longitudenal direction with a soldering iron and pull off injection valve.
  Caution: Catch any escaping fuel. Do not allow to drip onto hot parts of the engine.
  Warning: Before installing, grease the rubber seals at the valve mouth sleeve only lightly (silicone grease Ft 2 v 1). The other injection-valve parts must remain grease-free.
- Installation
- Plug on hose-termination sleeve (fuel-distribution pipe).
- Plug on injection valve (check for leaks at joints).
  Caution: After testing the injection valves and the fuel-distribution pipes, re-establish the original condition. Check for leaks (unmetered air).

Continued on M21/M22

1=Fuel-distribution pipe
2=Injection valves

1=Jumper with fuse holder and 10A fuse (user-fabricated)
2=Top view of pump relay connection base



Idle speed and CO concentration too low or too high (continued)

yes

CO measured value above test specification?
EU version:

0.8 vol.%CO

US version:

0.3 vol.%CO

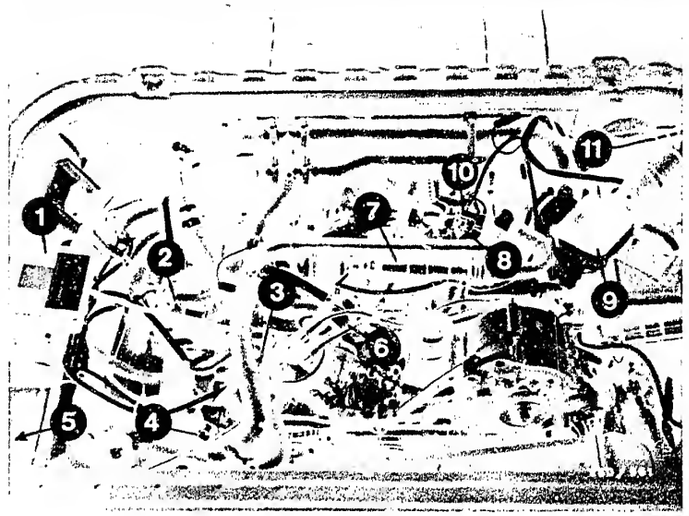
- Air-intake system tested for leaks with 0.3 bar gauge pressure?

yes

no

- Check whether hoses of air-intake system and of fuel line system are correctly connected, not kinked or damaged. If necessary, replace hoses. Eliminate leaks by new seals or by re-tightening the connecting screws.
- Leak test:
  Seal off the exhaust tail pipe. Loosen clamp-type fasteners on air filter. Lift off top part of air filter and seal off air-flow sensor duct. Disconnect hose after idle actuator (EU version) or auxiliary-air device (US version) and blow air (0.3 bar gauge pressure) into the intake manifold with a compressed-air gun. Seal off connection port on idle actuator/auxiliary-air device. Fully open throttle valve. Brush or spray all joints with soapy water. Leaks may also occur at the following points on the engine: oil dipstick not securely inserted, defective cap seal on oil filler neck etc. Bubbling or foaming indicates a leak.

Continued on M23/M24



EU version (US version similar)
1 =Main and pump relays
2 =Injection valves
3 =Central ground
4 =Temperature sensor II
5 =Control unit
6 =Pressure regulator
7 =Idle actuator
8 =Full-load switch
9 =Air-flow sensor
10=Idle switch
11=Idle controller
(behind a cover)

Idle speed and CO concentration too low or too high (continued)

yes

Trouble-shooting program completed for customer complaint

"Idle speed and CO concentration too low or too high".

Fault eliminated?

no

Further possibilities:

- Customer complaint incorrectly diagnosed (see Coordinates C3...C8).
  If the fault has not been diagnosed with the "Direct trouble-shooting chart", see "Detailed trouble-shooting chart" (Coordinates C3/C4).
- Engine not mechanically O.K. (compression, valve setting, valve timing, worn camshaft).

After-sales Service

Technical Bulletin

DETERMINATION OF THE TEMPERATURE VALUES GIVEN IN L-JETRONIC MANUALS

VDT-I-280/108 En
5.1982

We have recently been asked with increasing regularity how accurately the engine temperature must be measured when trouble-shooting on the vehicle.

So far in its L-Jetronic manuals KH/VSK has given three or four different temperatures for testing the temperature sensor:

-10 C, +20 C, +40 C and +80 C.

and two ranges for the thermo-time switch e.g. 35 C 8 sec.

below +30 C and above +40 C.

Since the temperature range need not be subject to such close tolerances, we propose in future the following more appropriate definition:

- Ambient temperature (approx. +15 C to +30 C)
- Engine at normal operating temperature (approx. +80 C).

Please direct questions and comments concerning the contents to our authorized representative in your country.

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After-sales Service

Technical Bulletin

CODING OF LE/LH-JETRONIC
SOLENOID-OPERATED INJECTION VALVES

VDT-I-280/109 En
5.1982

With the introduction of the LE/LH-Jetronic the internal resistance of the solenoid-operated injection valves has also been changed.

Injection valve

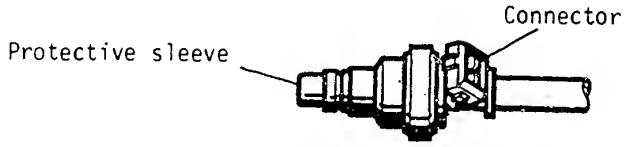
L-Jetronic	LE/LH-Jetronic
2.5 at + 20°C	16.2 Ω at + 20°C

The connector has been left the same for cost reasons and to meet customer wishes.

Caution!
If L-Jetronic injection valves are installed in an LE/LH-Jetronic vehicle, either the control unit or the injection valves will suffer irreparable damage.

Note:

- Install only injection valves with the part number designated for the vehicle.
- As a guide, injection valves with 16.2 Ω internal resistance have a yellow protective sleeve.



- A colour coding (yellow) of the connector (see also VDT-I-280/5) is not generally intended for LE/LH-Jetronic injection valves.

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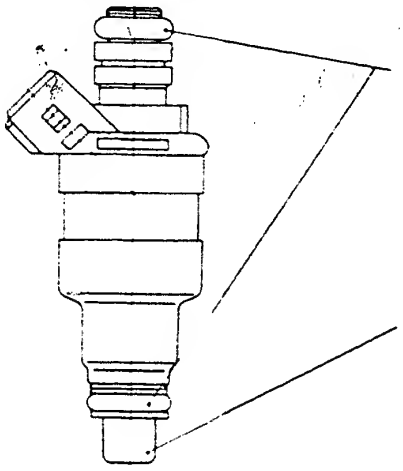
After-sales Service

Technical Bulletin

VDT-I-280/110 En
6.1983
Supersedes 6.1982 edition

PARTS SET FOR INJECTION VALVES
0 280 150 2..
AND PRESSURE REGULATORS 0 280 160 2..

A common parts set is available for the L-Jetronic/LE-Jetronic solenoid-operated injection valves and pressure regulators with the new method of connection.



Contents for 1 injection valve:

2 O-rings

1 protection sleeve, yellow

Contents for 1 pressure regulator:
1 O-ring
1 supporting plate

Since the above-mentioned parts are subjected to extreme temperature stress, they should be exchanged for new parts whenever servicing is carried out.

"Unmetered air" sucked in through injection-valve seals which are not tight, is a frequent case for servicing.

The parts set has the part number 1 287 010 704 and will in future be listed in the service parts microfiche under solenoid-operated injection valves (see EE 00 under 0 280..).

Please direct questions and comments concerning the contents to our authorized representative in your country.

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Technical Bulletin

PLUG CONNECTORS FOR
JETRONIC COMPONENTS
Parts sets

VDT-I-280/111 En
11.1984
(supersedes edition 11.1982)

Parts sets are available for replacement of Jetronic plug connectors. These consist of:

- Plug connector housing
- Protective cap (rubber sleeve)
- Contact springs

These parts are listed on microfiche EE...*.

* see microfiche EE00 under 0 280 ..

- Plug, black, 2-pin,
  parts set 1 287 013 002 cable connector in conjunction with socket, 2-pin

- Socket, black, 2-pin,
  parts set 1 287 013 001 for e.g.

Temperature sensor	0 280 130 0..
Auxiliary-air device	0 280 140 ..
Thermo-time switch	0 280 130 2..
Start valve	0 280 170 ..
Warm-up regulator	0 438 140 ..

- Socket, grey, 2-pin
  parts set 1 287 013 003 for:

Solenoid-operated injection valve	0 280 150 ..

- Socket, black, 3-pin,
  parts set 1 237 000 039 for:

  Throttle-valve switch 0 280 120 ..

- Socket, black, 5-pin,
  parts set 1 287 013 006 for:

  Air-flow sensor 0 280 20. ..
  (LE version)

- Socket, black, 6-pin,
  parts set 1 287 013 004 for

  Air-flow sensor 0 280 200 ..

- Socket, black, 7-pin,
  parts set 1 287 013 005 for:

  Air-flow sensor 0 280 20. ..
  Air-mass sensor 0 280 211 ..

- Wiring-harness plug connector, black, 25-pin
  parts set 1 287 013 009 for:

  Control unit 0 280 0..

- Wiring-harness plug connector, black, 35-pin,
  parts set 1 287 013 008 for:

  Control unit 0 280 0..

The contact springs (minitimers) are also available separately under part no. 1 284 477 026.

The plug-connector housings are only available in the stated colours.

Responsible:
Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please direct questions and comments concerning the contents to our authorized representative in your country.

After-sales Service

Motor Vehicle Service Information

UNIVERSAL TEST ADAPTER

VDT-I-Gen. 1001 En
1.1982

1. Application

The multiplicity of different fuel-injection and ignition systems at present available on the market, as well as the advances in development which can be expected in the future, demand a new testing concept. In order to maintain the outlay for test equipment, and hence the costs, at a reasonable limit we have developed the universal test adapter.

The following systems can be tested using a test-adapter universal unit together with adapter leads suited to the system in question:

1.1 Systems which are already being fitted as series:

- L-Jetronic (1st generation)
- LE-Jetronic (2nd-generation L-Jetronic)
- Motronic (with the new connector designation, refer to the vehicle-specific instructions!)

1.2 Systems whose introduction is planned:

- Motronic with gearbox control
- KE-Jetronic
- Mono-Jetronic
- Electronic ignition system with ignition map (EZF)

2. Delivery dates and Part Numbers

Available as from 2.1982.

2.1 Universal test adapter (basic unit)

Part Number: 0 684 101 801

Designation: ETT 018.01

2.2 System adapter lead for LE-Jetronic (2nd-generation L-Jetronic)

Part Number 1 684 463 123

First application: For BMW 2.5/2.8 l engines as from 9.1981, and for Opel 2.0 l engines (Manta/Rekord) as from 9.1981.

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2.3 System adapter lead for Motronic with new connector assignment.

(Refer to the vehicle-related instructions!)

Part Number : 1 684 463 124
First application: Porsche 944 as from series production, BMW as from about 3.1982 (Europe)

2.4 System adapter lead for L-Jetronic (in preparation)

Further system adapter leads will be made available along with the introduction of the new systems as mentioned above.

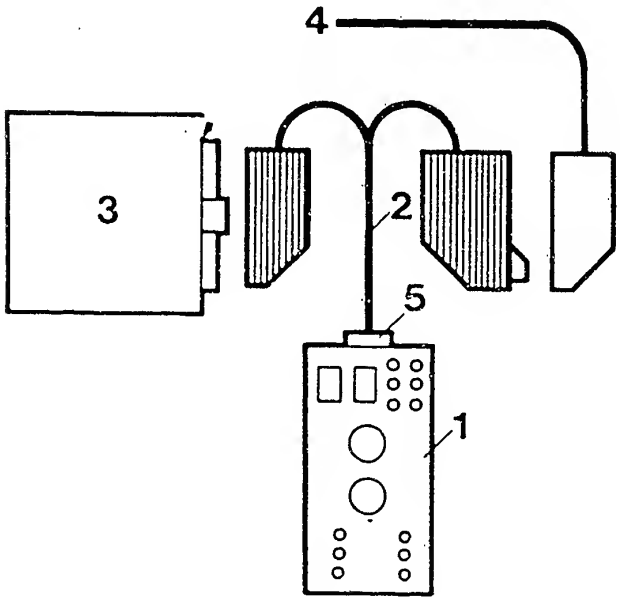
3. Testing procedure

The systems and the components are tested for voltage and resistance values as well as for correct functioning. Evaluation is by means of a multimeter and the Motortester which are connected into the universal test adapter.

Depending upon the complexity of the system, interchangeable adapter lead model 1 or model 2 is provided:

3.1 Adapter lead for peripheral and function testing (Model 1)

The universal test adapter together with the system adapter lead is to be connected to the system wiring harness and to the control unit (e.g. Motronic).
To be tested: Wiring harness with components and control unit.

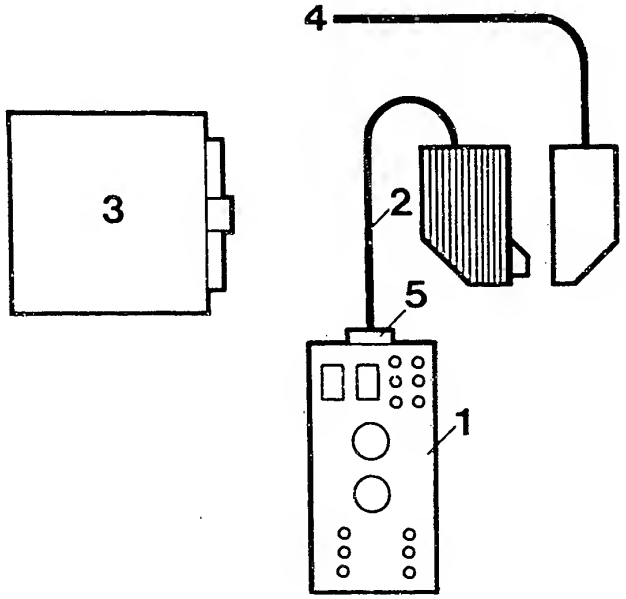


1 = Universal test adapter (basic unit)
2 = System adapter lead (Y-version)
3 = Control unit
4 = System wiring harness
5 = Plug connection

3.2 Adapter lead for peripheral testing (Model 2)

The universal test adapter with system adapter lead, is only to be connected to the system wiring harness (e.g. LE-Jetronic (2nd-generation L-Jetronic)).

To be tested: Wiring harness with components (without control unit).

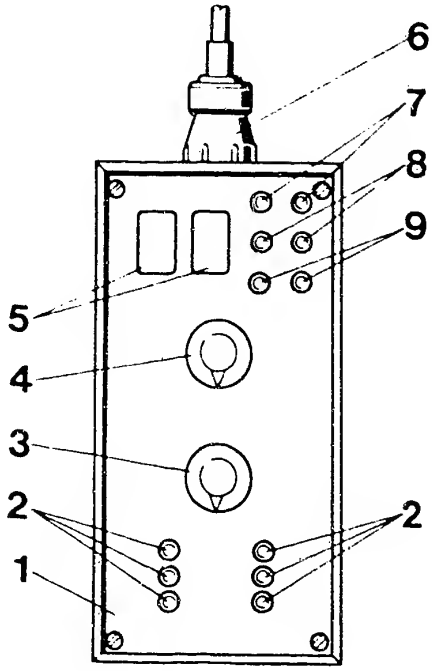


1 = Universal test adapter (basic unit)
2 = System adapter lead
3 = Control unit (not connected)
4 = System wiring harness
5 = Plug connection

4. Construction of the universal test adapters

The universal test adapter is fitted with 2 program switches footage and resistance measurement. The measured values are displayed on the multimeter connected to the universal test adapter. For reasons of safety, the voltage and resistance sockets are separated. In order to measure signals (e.g. injection pulses, ignition pulses), it is necessary to connect a Motortester to the measuring cavities (special input).

When carrying out functional tests with the control unit connected, selected push-buttons are pressed in a number of test-program steps in order to simulate a variety of different engine operating conditions the influence of which is evaluated using the Motortester.



1 = Universal test adapter (basic unit)

2 = Keyboard for simulation of various conditions e.g. engine temperature, throttle position etc.

3 = Program switch "Ohm" for resistance measurement

4 = Program switch "Volt" for voltage measurement

5 = Measurement "cavities" (for the special input from the Motortester)

6 = 63-pole plug-in connection for connecting the system adapter lead

7 = Measurement sockets (voltage measurement with a multimeter or with the Motortester)

8 = Measurement sockets (resistance measurement with the multimeter)

9 = Sockets for special functions (not yet allocated)

Notes:

1. The Motronic test adapter (0 684 101 800, ETT 018.00) will continue to be used for Motronic-equipped BMW vehicles (with old connector assignment) up to about year of manufacture 3.1982 (refer to vehicle-specific instructions).

2. Details on the operation of the universal test adapter, and the test specs, are to be found in the vehicle-specific after-sales service instructions.

3. Caution! Change of Part Number:

On the SIS-microfiches OPE-00/J22 (Coordinates A14 and A17) the new Part Numbers are as follows:

Universal test adapter: 0 684 101 801

Adapter lead : 1 684 463 123

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When direct trouble-shooting a specific L2-Jetronic component, it is absolutely essential to look up the respective test step under the customer compiaint.

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Trouble-shooting program

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